

SECTION 2

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2. THE HITCHHIKER CARRIER SYSTEM

The HH carrier system implements various modular hardware in mounting customer equipment in the payload bay. HH-S customer equipment is mounted in canisters, on small mounting plates, or directly to the Orbiter adapter beams. HH-C customer hardware is mounted to the HH bridge using standard canister hardware, small experiment mounting plates, or custom-mounting equipment. The standard avionics unit forms a part of both the HH-S and HH-C configurations. This unit provides the electrical interface between the Orbiter and up to six customer units. The weights of the various carrier units and their maximum customer weight capacities are shown in Table 2.1. Actual allowable customer weight depends on detailed analysis of actual mounting configuration and center of gravity. Table 2.1. also shows the weights of the GAS-type beam (attachment hardware for HH-S) and Keel Trunnion attachment hardware (used with HH-C). The attachment hardware weight is not counted in determining reimbursement to NASA for transportation cost.

Customer interfaces for the side-mount and cross-bay versions of HH have been designed to be as similar as possible allowing many customer payloads to be accommodated on either carrier. This results in maximum manifesting flexibility.

An additional HH version, Hitchhiker-JR (HH-J) is available for small instruments which require only canister mounting and do not require real-time ground command or data services. HH-J has customer electrical interfaces similar to GAS and can be accommodated on Shuttle missions where Orbiter electrical services required by the standard HH carrier are not available. HH-J customers are not required to support the control center operations required by the other HH versions and can avoid the cost and effort associated with the necessary equipment and personnel.

TABLE 2.1 HH CARRIER EQUIPMENT CAPACITIES

Carrier Equipment	Maximum Carrier Weight (lbs)	Customer Weight (lbs)	Mounting Surface
Sealed Canister (insulated top plate)	160	200	19.75" Dia.
Sealed Canister (uninsulated top plate)	140	200	19.75" Dia.
Motorized Door Canister	235	170	19.75" Dia.
HH-S Small EMP	55	300	25" x 39"
HH-S Direct Mount	-	700	20" x 40"
HH-C Side Mounting Plate (Experiment) (No Brackets)	61	250*	25.6" x 39.5"
HH-C Small Top Mounting Pallet (Exp.)	90	600*	33.38" x 27.45"
HH-C Large Top Mounting Pallet (Exp.) (No Brackets)	207	600*	55.65" x 33.38"
Avionics Unit (includes mounting plate & mounting hardware)	236	--	--
HH-C (includes avionics unit, mounting plate and standard MPE)	2165	1200	Custom-mounted
<u>Attachment Hardware</u>	<u>Weight</u>		
HH-S GAS Beam, Bays 2-8, 12, 13	70 lbs.		
HH-C Bridge Attachment Fittings for Bay 2	365 lbs.		
HH-C Bridge Attachment Fittings for Bay 3	418 lbs.		

*Specific center of gravity envelope limits weight capability.

2.1 *Mechanical Support Systems*

HH-S and customer hardware will be side-mounted to the Orbiter payload bay longeron and frame attachment points using GAS-type adapter beams. HH-S carrier components are illustrated in Figure 2.1. HH-C payloads are carried on an across-the-bay structures as described in section 2.1.4.

Existing HH-S equipment is designed to be mounted on the starboard side of the cargo bay in bay locations 2 or 3. These locations are indicated in Figure 2.2 which shows the forward-most available positions in the bay for the GAS adapter beam mounting as well as the X-axis station numbers associated with these positions.

Figure 2.3 depicts an example of a typical structural configuration for HH-S payloads. Figure 2.4 shows a sideview of a typical HH-S payload mounting.

All plates that are to be side-mounted to the Orbiter are parallel to the X-Z plane. The X axis is along the long axis of the Orbiter; positive towards the tail. The Y axis is across the payload bay positive towards the starboard (right) wing. The Z axis completes the coordinate system and is positive moving "up" from the bottom of the Orbiter payload bay. See Figure 2.5.

The dynamic envelope of the cargo bay defines the maximum permitted extent of thermal and dynamic distortions of payload equipment. A maximum static design radius of 88 inches has been established for customer hardware (Figure 2.6). The maximum dynamic envelope radius is 90" (Figure 2.6). The maximum extent of payload equipment out from the sides of the mounting plates (along the Orbiter + X directions) is mission-dependent. It will normally, however, be restricted to the width of the mounting plate to prevent interference with Orbiter integration Ground Support Equipment (GSE).

The following subsections describe the various mechanical accommodations available with the HH-S system.

Hitchhiker-S Carrier Components

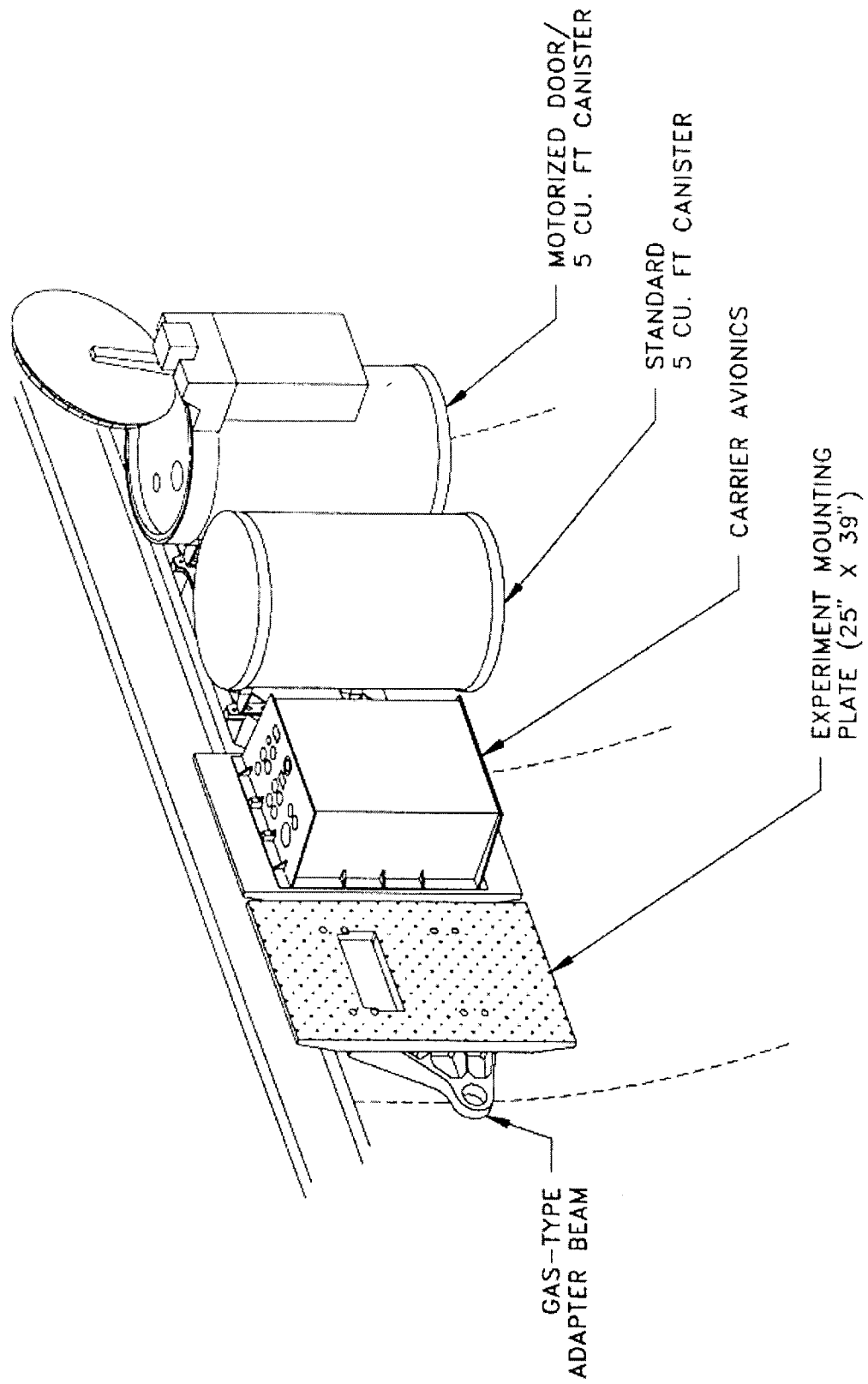


FIGURE 2.1 HITCHHIKER-S CARRIER COMPONENTS

Hitchhiker-S Available Sidewall Mounting Locations

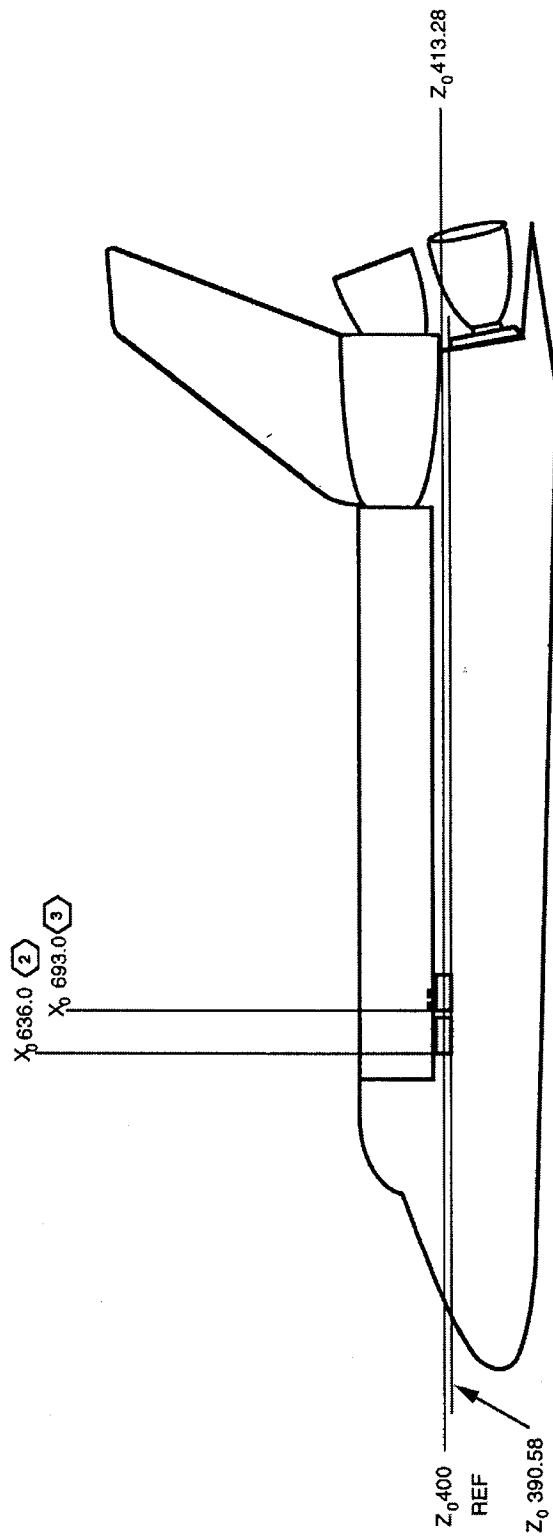


FIGURE 2.2 HITCHHIKER-S AVAILABLE SIDEWALL MOUNTING LOCATIONS

Hitchhiker-S Typical Structural Configuration

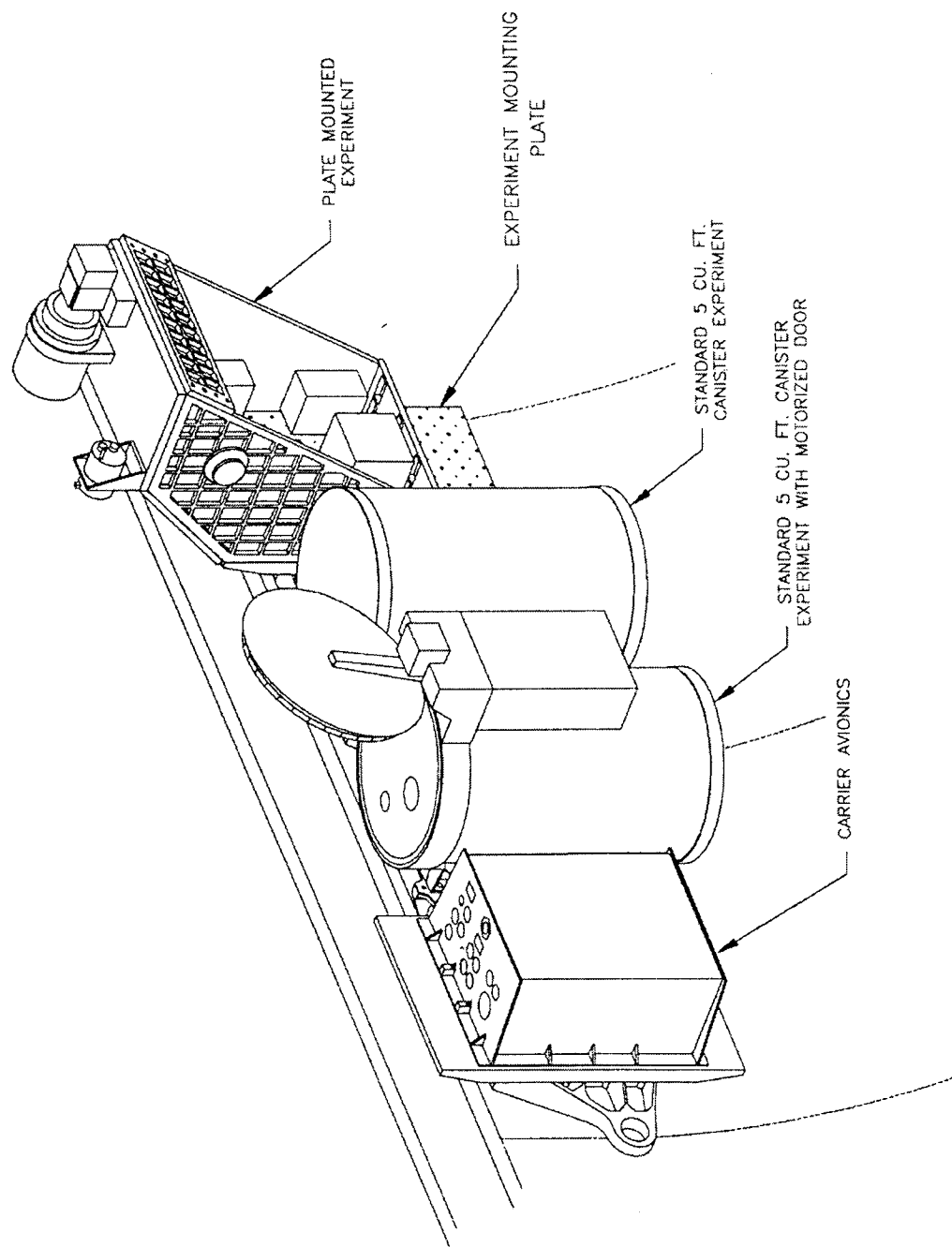
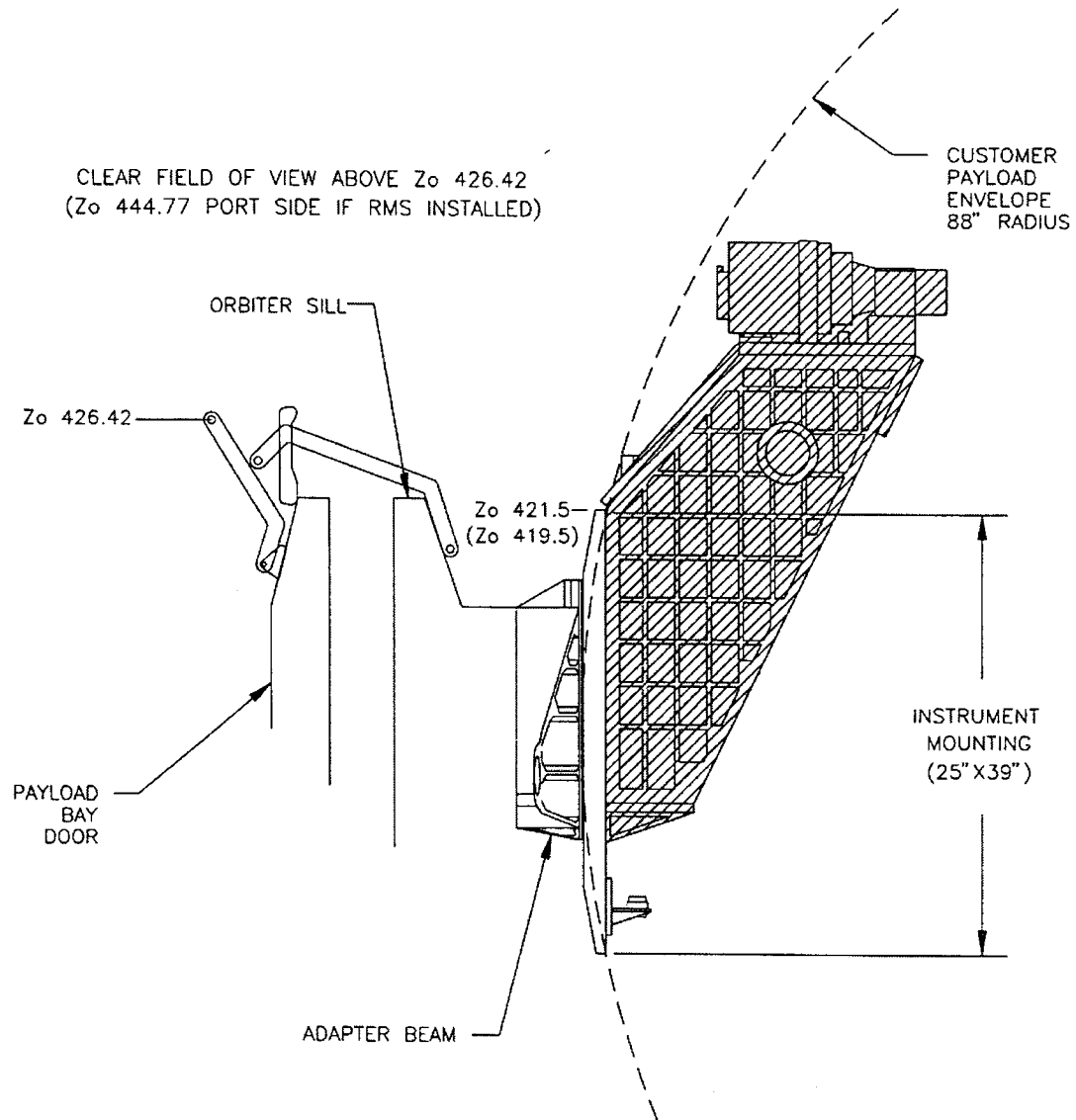


FIGURE 2.3 HITCHHIKER-S TYPICAL STRUCTURAL CONFIGURATION

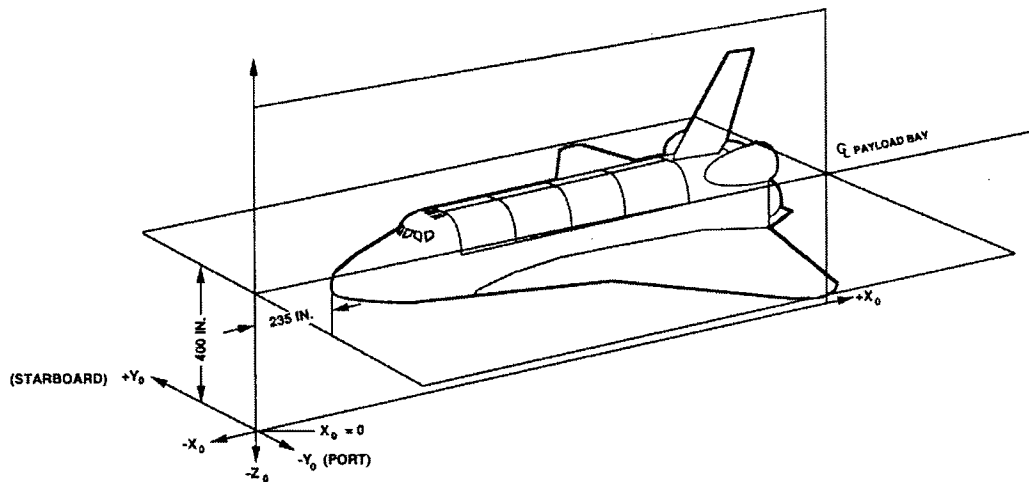
Hitchhiker-S Payload Mounting Concept (Sideview)



NOTE: Zo Coordinate in parenthesis indicates lower mounting position.

FIGURE 2.4 HITCHHIKER-S PAYLOAD MOUNTING CONCEPT (SIDEVIEW)

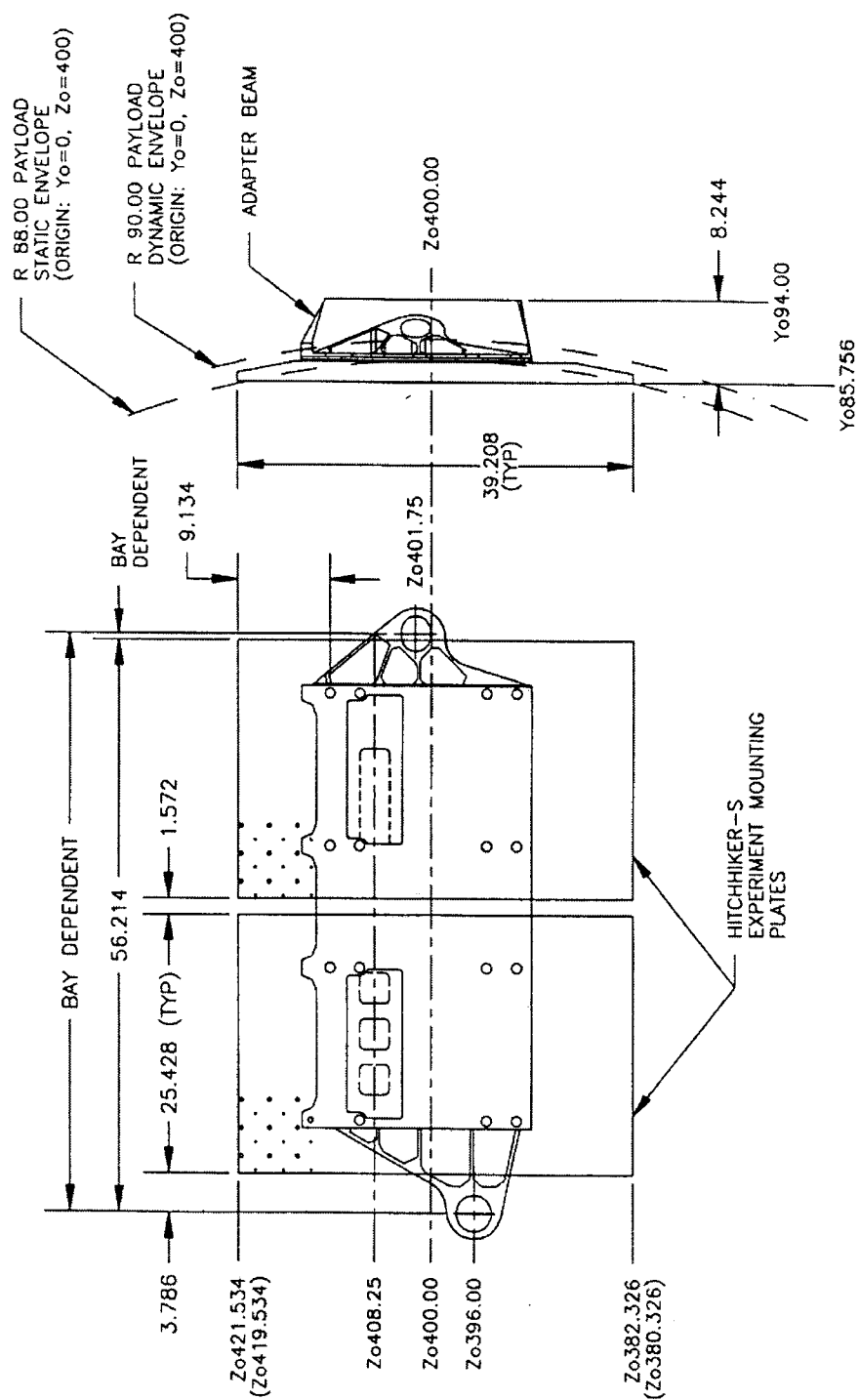
Orbiter Coordinate System



- ORIGIN:** IN THE ORBITER PLANE OF SYMMETRY, 400 INCHES BELOW THE CENTER LINE OF THE PAYLOAD BAY AND AT ORBITER X STATION = 0.
- ORIENTATION:** THE X₀ AXIS IS IN THE VEHICLE PLANE OF SYMMETRY. PARALLEL TO AND 400 INCHES BELOW THE PAYLOAD BAY CENTER-LINE. POSITIVE SENSE IS FROM THE NOSE OF THE VEHICLE TOWARD THE TAIL.
- THE Z₀ AXIS IS IN THE VEHICLE PLANE OF SYMMETRY, PERPENDICULAR TO THE X₀ AXIS POSITIVE UPWARD IN LANDING ATTITUDE.
- THE Y₀ AXIS COMPLETES A RIGHT-HANDED SYSTEM.
- CHARACTERISTICS:** ROTATING RIGHT-HANDED CARTESIAN. THE STANDARD SUBSCRIPT IS 0 (e.g. X₀)

FIGURE 2.5 ORBITER COORDINATE SYSTEM

Maximum Payload Static and Dynamic Envelopes Small Mounting Plate Layout



NOTE: Zo coordinates in parenthesis indicate lower mounting position.

FIGURE 2.6 MAXIMUM PAYLOAD STATIC AND DYNAMIC ENVELOPES

2.1.1 HH Canister

The HH canister is an adaptation of the canister developed by the GAS Program. It is mechanically very similar to a GAS canister and offers the customer the simplest mechanical accommodation in the HH-S system. It is available as a completely closed canister (Figure 2.7) or with an opening lid known as the Hitchhiker Motorized Door Assembly (HMDA) (Figure 2.8). Figure 2.9 shows the canister mechanical and electrical components. Figure 2.10 illustrates the field-of-view restrictions for payloads using the HMDA. Canister extensions to facilitate additional payload volume are available as an optional service and will be considered on a case-by-case basis.

Use of the standard container facilitates safety. The container provides for internal pressure which can be varied from near vacuum to about 1 atmosphere absolute. It also provides thermal protection for the experimental apparatus. The sides of the container may be thermally insulated or may be uninsulated with a white paint surface. The top may be insulated or not, depending upon the customer requirements. The bottom of the container is always insulated.

The experiment mounting plate, which is also the upper end plate of the canister, provides a standardized mounting surface for customer hardware. Any experiment venting will be through the experiment mounting plate. The lower end plate contains ports through which a payload may vent. The HMDA uses a different experiment mounting plate and similar, but different, payload venting.

The weight the canister can support depends upon whether it is mounted for a HH-S or HH-C configuration. For the HH-S configuration, the canister is qualified to support 200 lbs. of payload weight. The HH-C configuration is qualified to carry a total of 400 lbs. for the canister carrier weight and payload weight. If the canister carrier weight to support a payload increases, then the payload weight that can be flown is reduced. For example, a standard insulated canister with an uninsulated top plate weighs about 140 lbs., this would limit the payload to 260 lbs. If the payload required the HMDA, then the payload weight allowed would be reduced by the weight of the HMDA.

2.1.1.1 Container Construction

The standard container is made of aluminum. There is white paint or multilayer insulation on the exterior. The top may or may not be insulated depending on the particular Shuttle mission and needs of the experimenter. The circular top and bottom end plates are 5/8" thick aluminum.

The bottom 3" of the container is reserved for HH-S interface equipment such as interface harnesses and venting systems. This volume is in addition to the 5-cubic foot space available to the experimenter.

The container is a pressurized container capable of:

- a. maintaining about 1 atmosphere absolute pressure at all times, (dry nitrogen or dry air),
- b. evacuation during launch and repressurization during re-entry (vented).
- c. evacuation prior to launch.
- d. evacuation on orbit with vacuum being maintained through re-entry.

Hitchhiker Sealed Canister

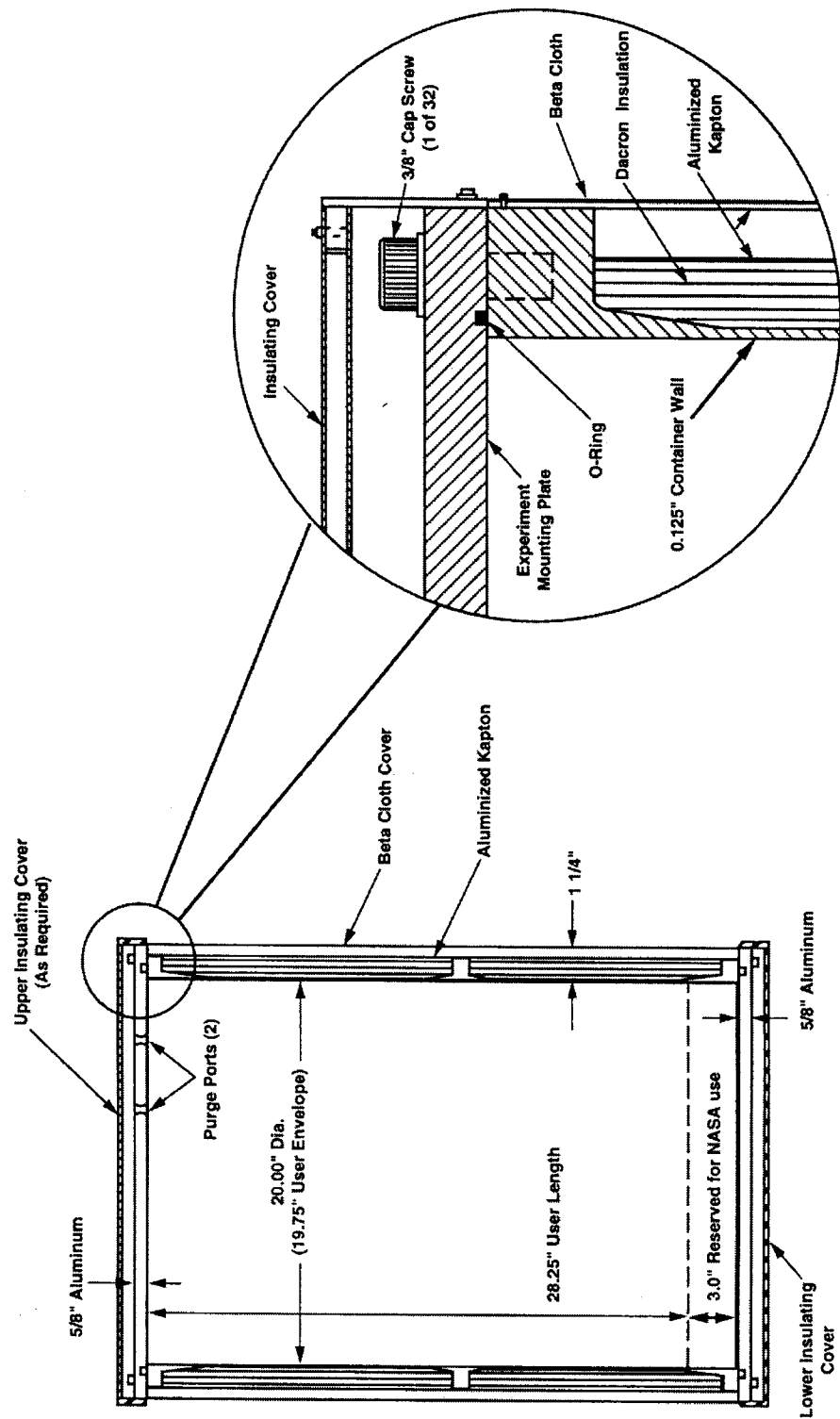


FIGURE 2.7 HITCHHIKER SEALED CANISTER

Hitchhiker Motorized Door Canister

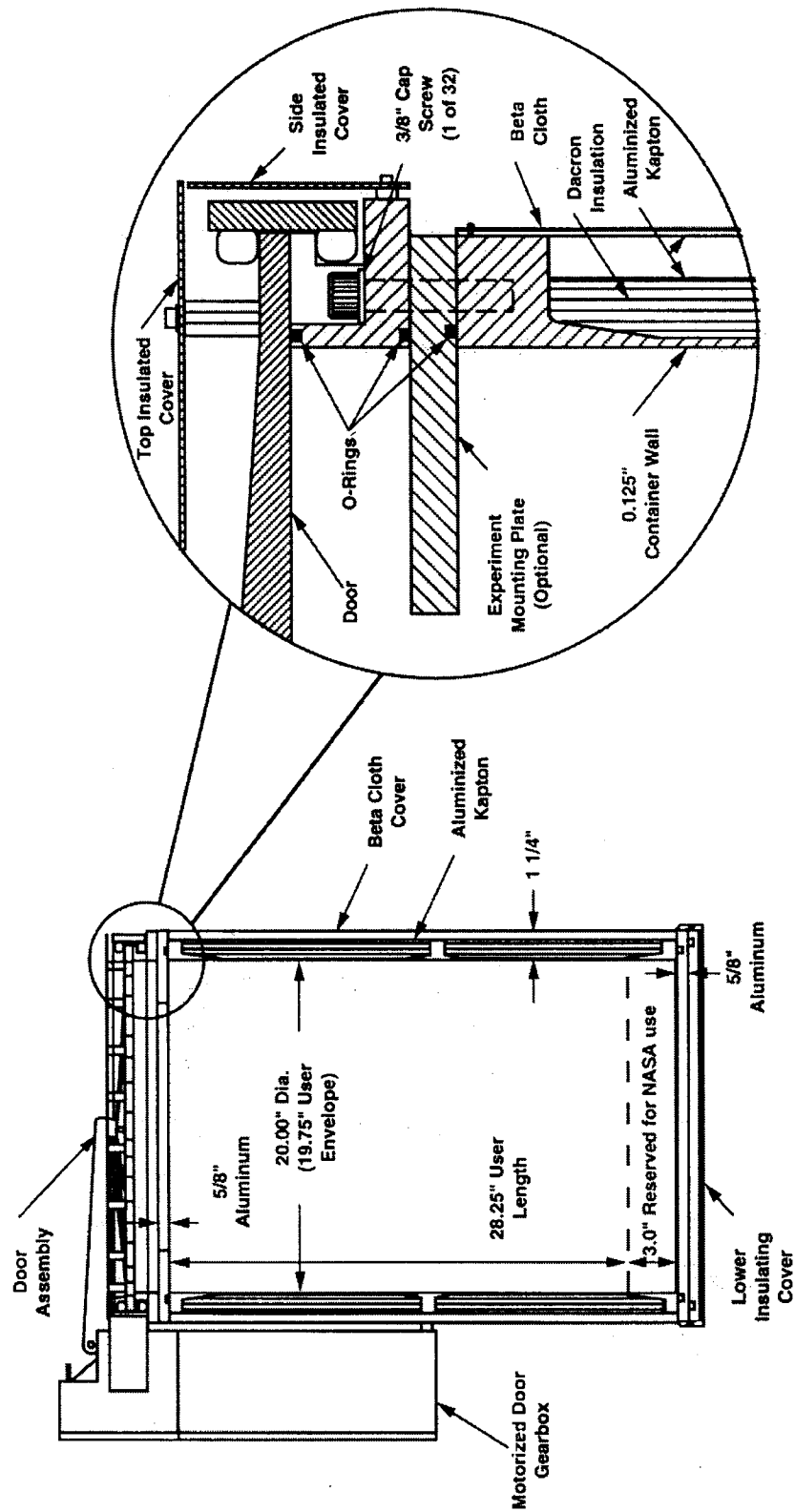


FIGURE 2.8 HITCHHIKER MOTORIZED DOOR CANISTER

Hitchhiker Canister

Mechanical and Electrical Components

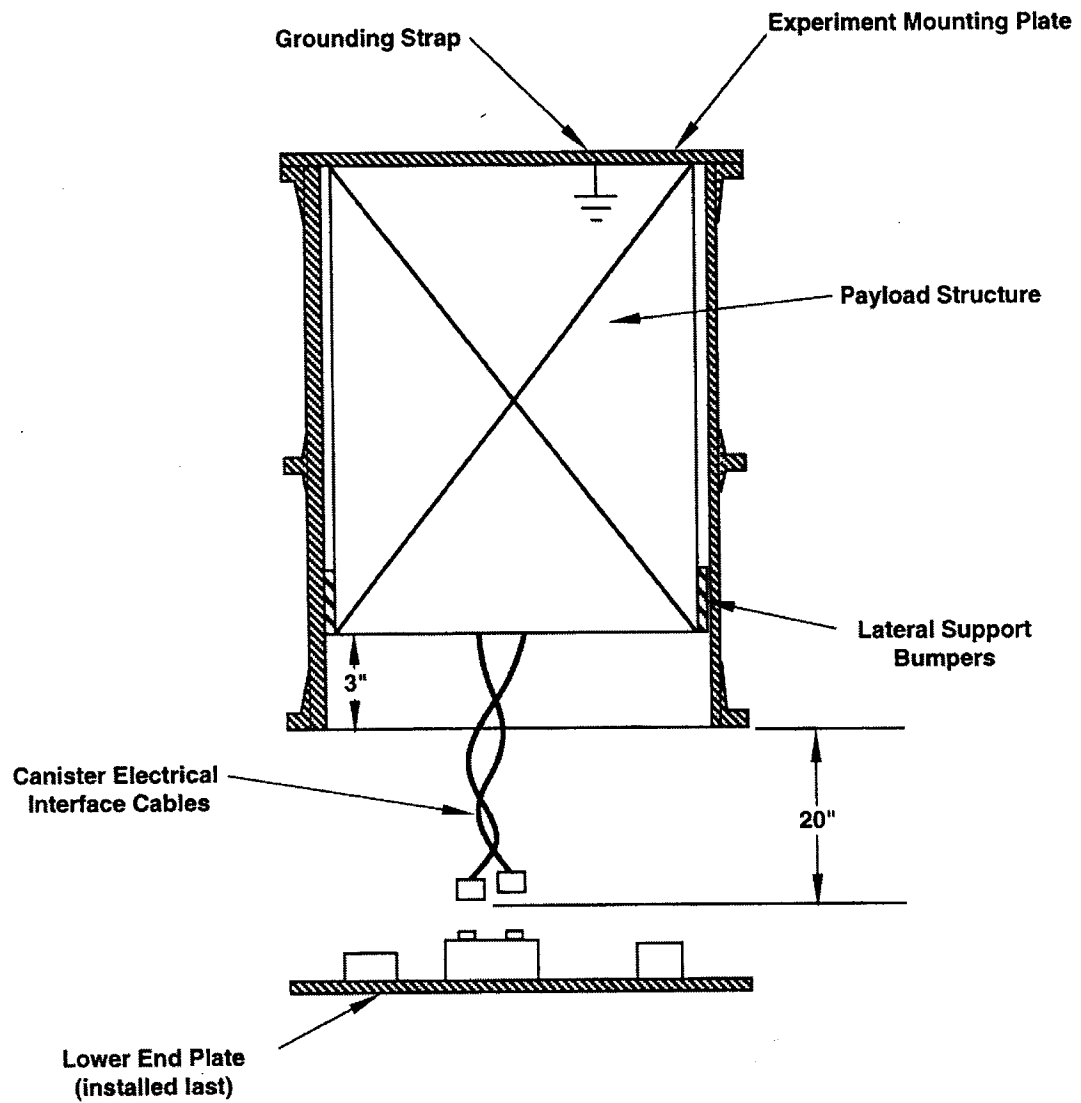


FIGURE 2.9 HITCHHIKER CANISTER

Hitchhiker-S Canister Mounting To Orbiter View Looking Forward - Port Side

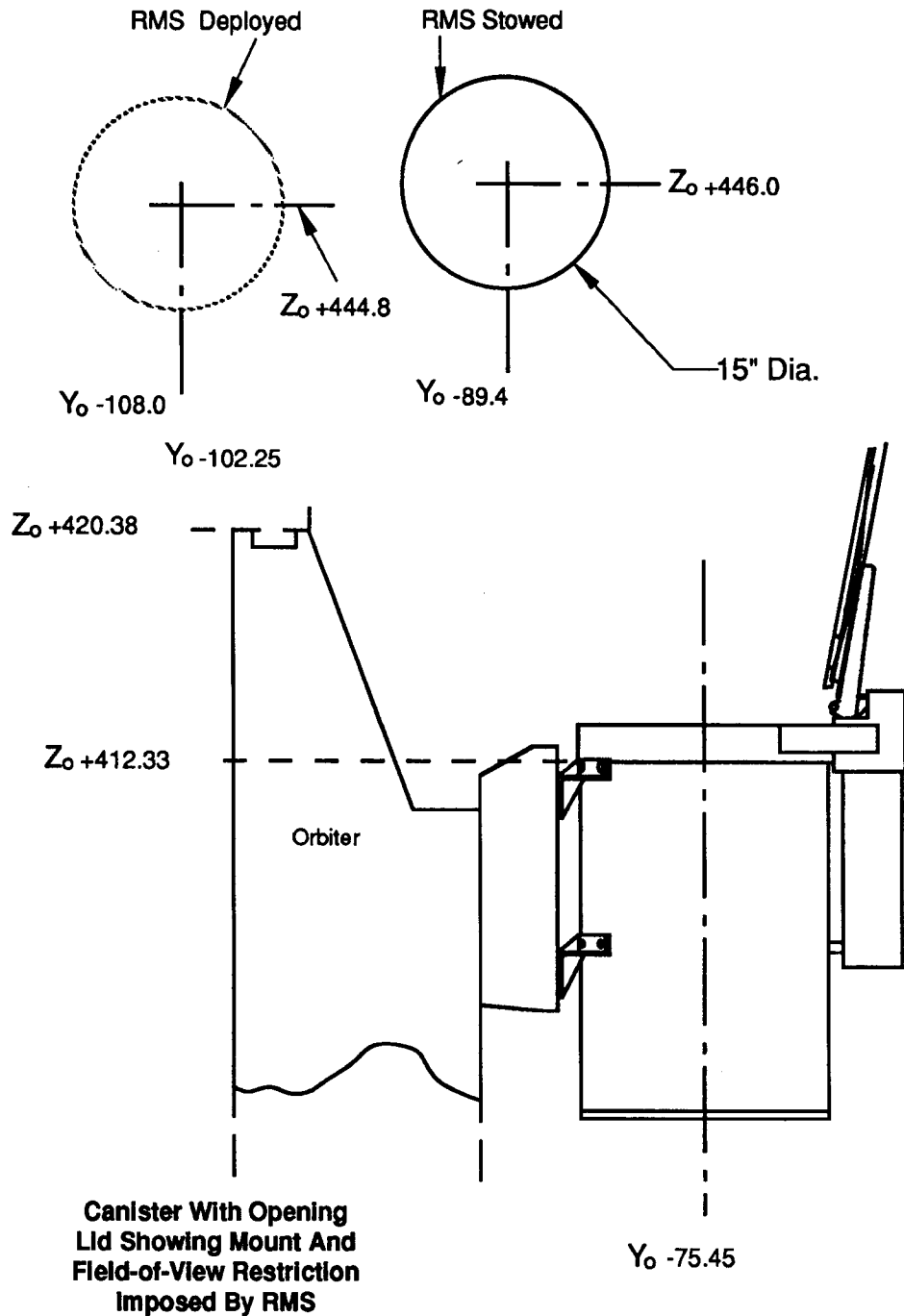


FIGURE 2.10 HITCHHIKER-S CANISTER MOUNTING TO ORBITER

2.1.1.2 Sealed Canister Experiment Mounting Plate

The sealed canister upper end plate (see Figure 2.11) serves four purposes:

- a. it seals the upper end of the standard container,
- b. it provides a mounting surface for the experimental equipment,
- c. it can act as a thermal absorption or radiation surface, and
- d. it provides accommodations for experiment box venting when required.

The inner surface of the plate has a hole pattern adaptable for mounting a variety of hardware. Forty-five stainless steel, internally threaded inserts exist for experiment mounting purposes. The experimenter may use any of them in any combination required. The inserts do not go through the plate. They will accept #10 - 32 UNF machine screws to a depth of 0.31 inches. The project is responsible for approving the structural dimensions of the experiment interface and the number and location of mounting screws.

The line from the center of the plate through the two purge ports will always be positioned toward the starboard (right) side of the Orbiter, perpendicular to the Orbiter centerline.

The canister will be purged with dry nitrogen, or dry air, as specified by the customer. Two purge ports are shown on the experiment mounting plate (see Figure 2.11). At least one of these must be unobstructed to allow purged gas to flow through the canister.

The customer must provide a grounding strap from the payload to the experiment mounting plate. Any mounting hole on the experiment mounting plate may be used for grounding.

If safety considerations require that a battery box or other component be vented, it can be plumbed to a special pressure-relief valve turret (illustrated in Figure 2.12). Since the turret can be rotated 360°, the experimenter can pick the most convenient orientation within the plumbing circle shown in Figure 2.11. If no turret is required for the payload, this area will be completely clear and will not affect payload mounting.

The customer must provide attachment points on the bottom of the payload structure for lifting in the inverted orientation by means of a crane and sling. The sling must be provided by the customer. Customers may not alter the mounting plate unless changes have been negotiated with the HH Project Office. As an optional service to be individually negotiated, the top mounting plate may be modified to provide apertures or customer electrical connectors. Customer equipment may be mounted to the top (external) surface of the mounting plate.

Hitchhiker Sealed Canister

Standard Experiment Mounting Plate (Upper End Plate)

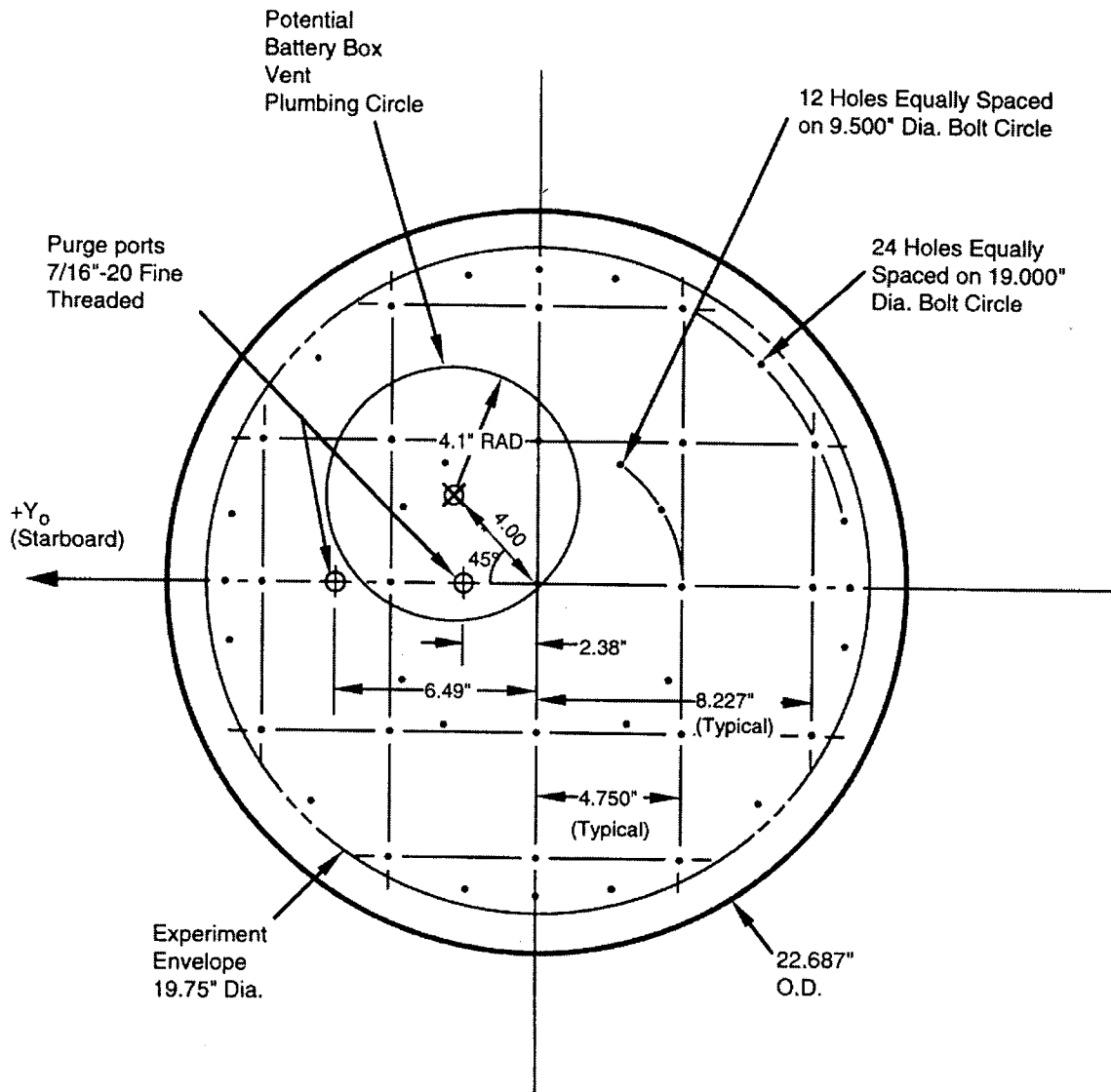


FIGURE 2.11 HITCHHIKER SEALED CANISTER (UPPER END PLATE)

Hitchhiker Sealed Canister Battery Vent Turret Interface

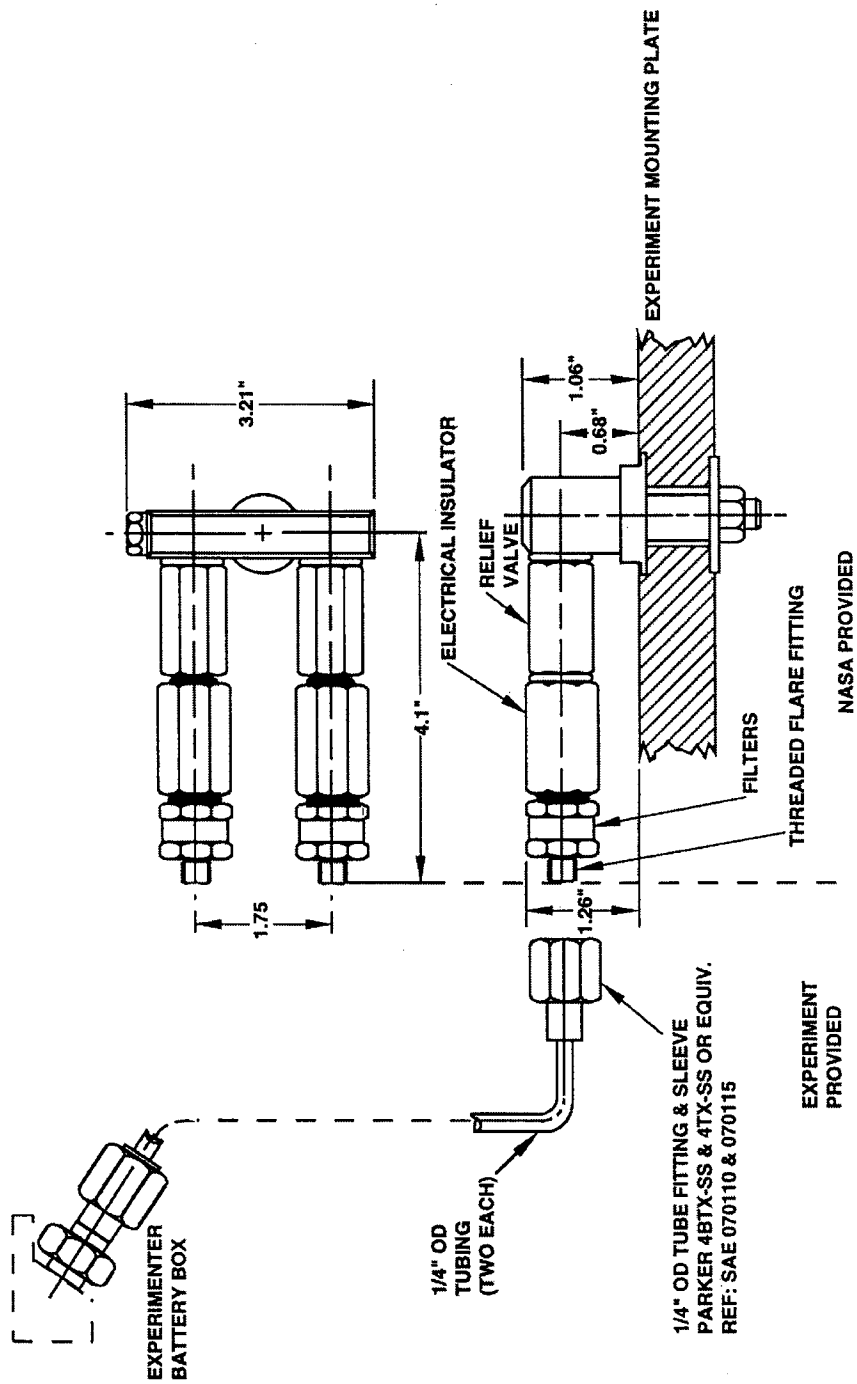


FIGURE 2.12 HITCHHIKER SEALED CANISTER – BATTERY VENT TURRET INTERFACE

2.1.1.3 Opening Lid Canister

A canister may be fitted with a HMDA if the customer payload requires a field of view or exposure to the space environment. The door is opened and closed by ground command as required. The HMDA is capable of maintaining a 15 psi differential (psid) pressure or evacuated environment similar to the standard canister. It is possible to eject packages from a HMDA canister; however, the interface and safety requirements are considerably beyond the scope of this document and must be defined and approved on a case-by-case basis.

HMDA canisters are normally equipped with redundant pressure-relief valves which act to reduce the pressure to less than 1 psid during ascent. Once in orbit, a ground command may be used to open a vent valve and reduce the pressure to less than 0.1 psid prior to opening the door. HMDA canisters normally return with internal vacuum.

The mounting provisions for the opening lid canister are shown in Figure 2.13. Because the contents of the canister are exposed when the door is open, the materials, safety, and Electro-Magnetic Interference (EMI) considerations are essentially the same as for plate-mounted hardware.

For safety considerations, a pressure-relief valve turret designed for use on the HMDA Mounting Plate is available to vent battery boxes or other components (see Figure 2.15). Four venting locations have been provided to accommodate battery box orientation requirements. An experiment may use any one of these four locations. If no turret is required for the payload, this area will be completely clear and will not affect payload mounting.

Multiple interlocks are provided to prevent the door from opening prior to or during ascent. However, in the event of an in-flight door failure, the contents of the canister must be designed to allow safe descent and landing with the door open. The customer is responsible for designing and providing any thermal treatment of exposed surfaces.

2.1.1.4 Canister Orientation

A canister will always be mounted with the experiment mounting plate facing out of the payload bay. There are, however, two different container ground handling orientations. First, during insertion of a payload into the container and the subsequent checkout and transportation, the container's major axis will be vertical. Second, after the container is installed in the Orbiter bay, the container's orientation will become Orbiter dependent, i.e., the major axis of the container will be perpendicular to that of the Shuttle.

Care should be taken in experiment design to assure that systems that are sensitive to ground orientations, such as wet cell batteries, are properly oriented in the experiment. The customer should inform the HH staff of any special payload orientation requirements which must be met prior to installation in the Orbiter.

2.1.1.5 Lateral Load Support

Because the experiment structure will be cantilevered from the experiment mounting plate, radial loads at the free end of the experiment structure must be supported by at least three equally spaced bumpers between the experiment structure and the canister. Figure 2.16 illustrates one possible bumper design configuration.

The customer is responsible for providing bumpers as part of the experiment hardware. Bumper design should be in accordance with the following guidelines:

- a. A minimum surface area of 4 in² (2" x 2") should be used for each bumper pad.
- b. The bumper face should have a 10-inch radius so that it will fit snugly when adjusted against the 20-inch diameter container.
- c. Where the bumper contacts the container wall, it should be faced with a resilient material at least 1/8 inch thick to protect the container. If the container is to be evacuated, select a non-outgassing material such as viton. If the bumper face is not round, every corner should have a minimum radius of 0.40 inches.
- d. It is very important to provide a positive locking device for the bumpers. Do not depend on friction or a set screw alone to hold them in place.
- e. After installing the payload in the container, bumper adjustment should be easily accessible from the open lower end of the container.

2.1.1.6 Center of Gravity (CG) Considerations

To minimize the amount of analysis required for a particular mission, the composite CG of a canister and payload must be constrained within certain limits. The CG envelope is shown in Figure 2.14.

Opening Lid Canister Experiment Mounting Plate

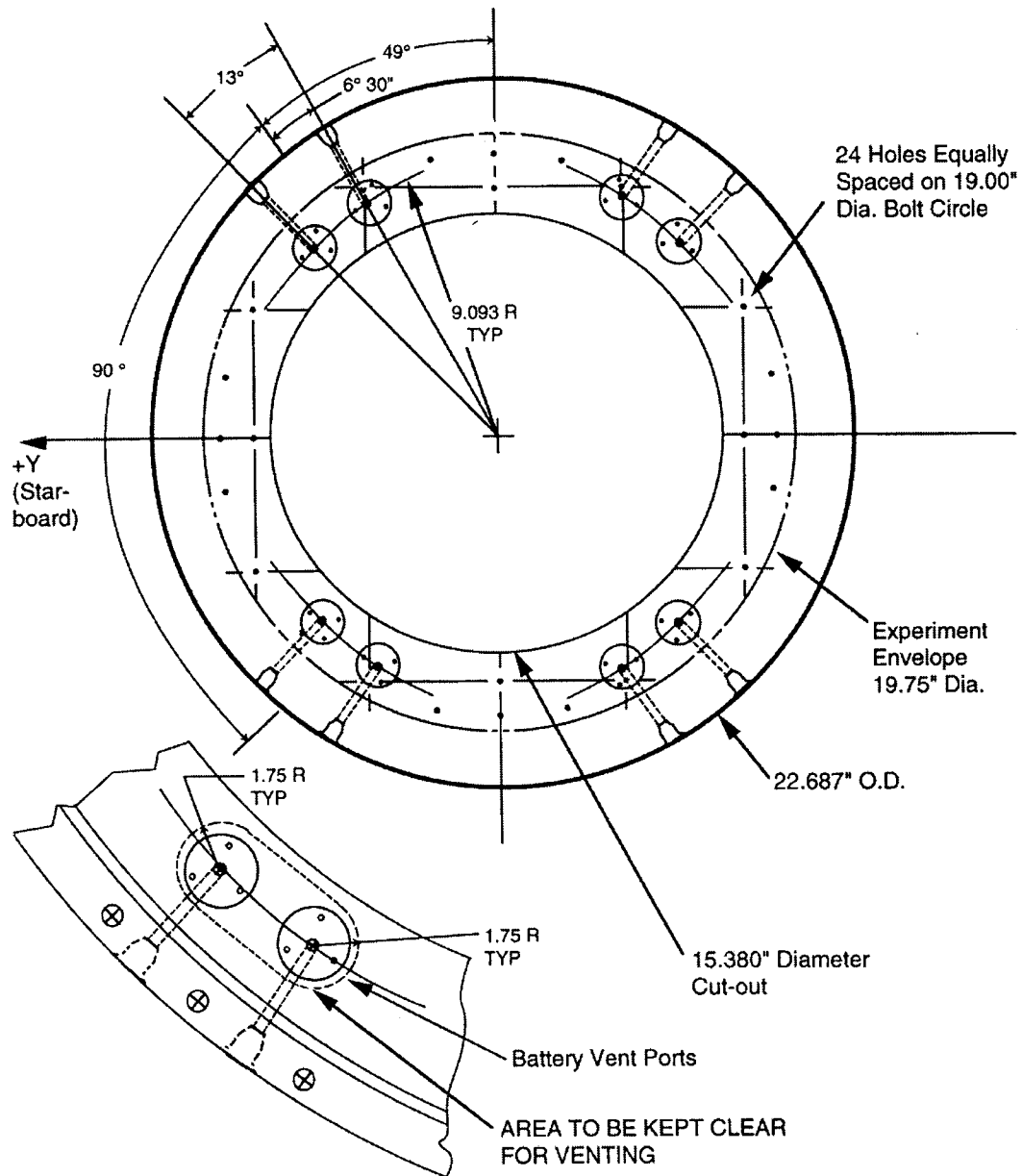


FIGURE 2.13 OPENING LID CANISTER – EXPERIMENT MOUNTING PLATE

Canister CG Envelope Adapter Beam or Bridge Mounting

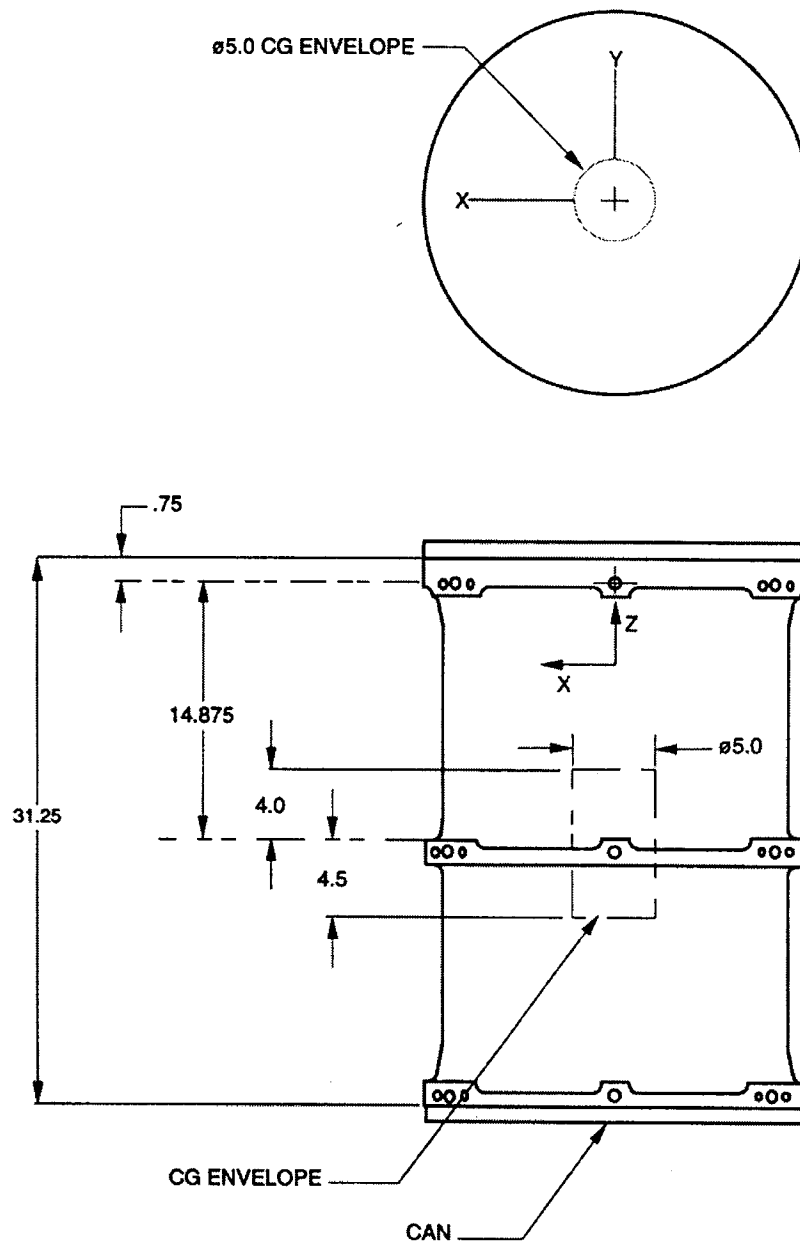


FIGURE 2.14 CANISTER CG ENVELOPE-ADAPTER BEAM OR BRIDGE MOUNTING

Hitchhiker Motorized Door Canister Battery Vent Assembly

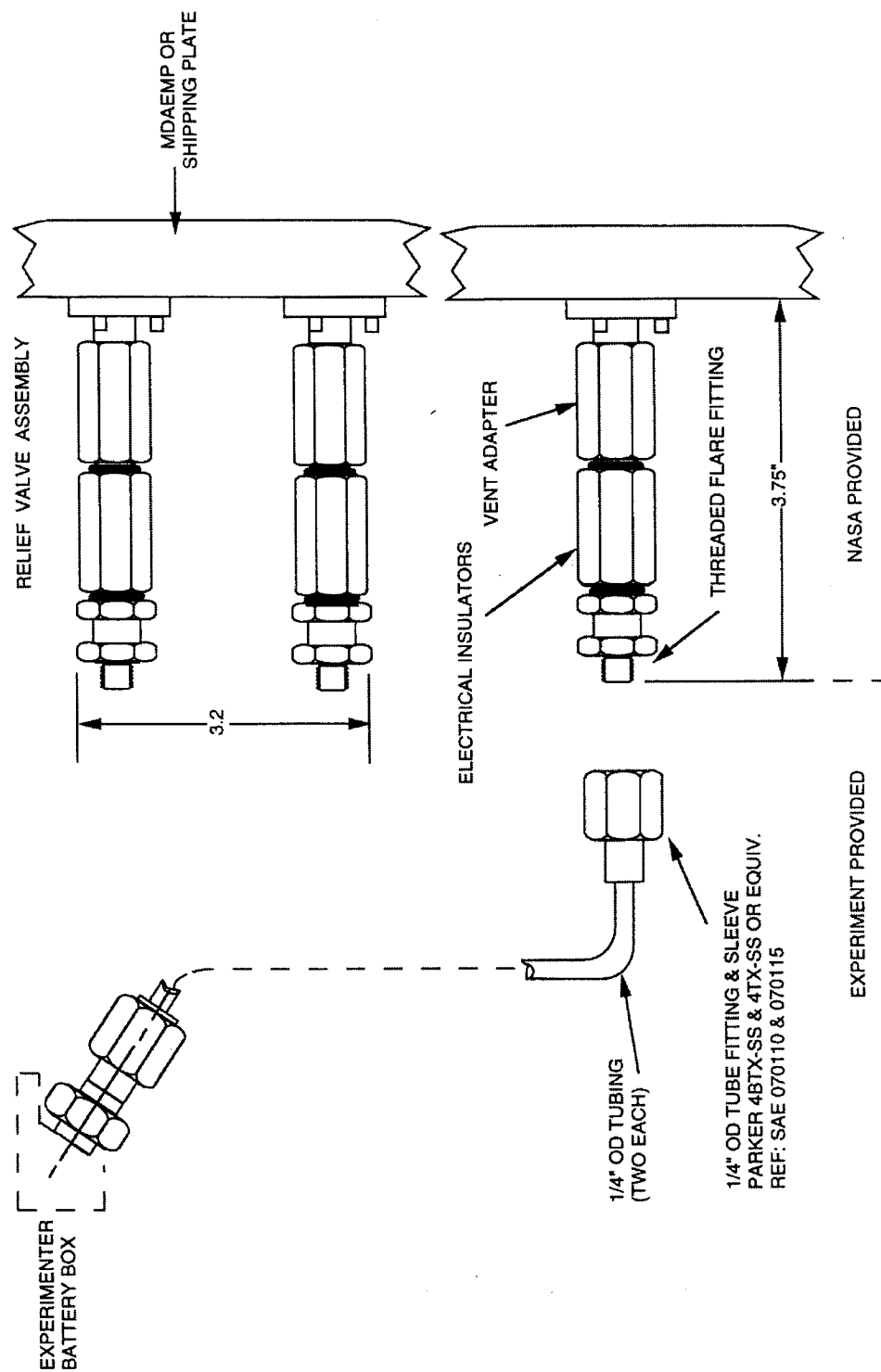


FIGURE 2.15 HITCHHIKER MOTORIZED DOOR CANISTER – BATTERY VENT ASSEMBLY

Bumper Design Example

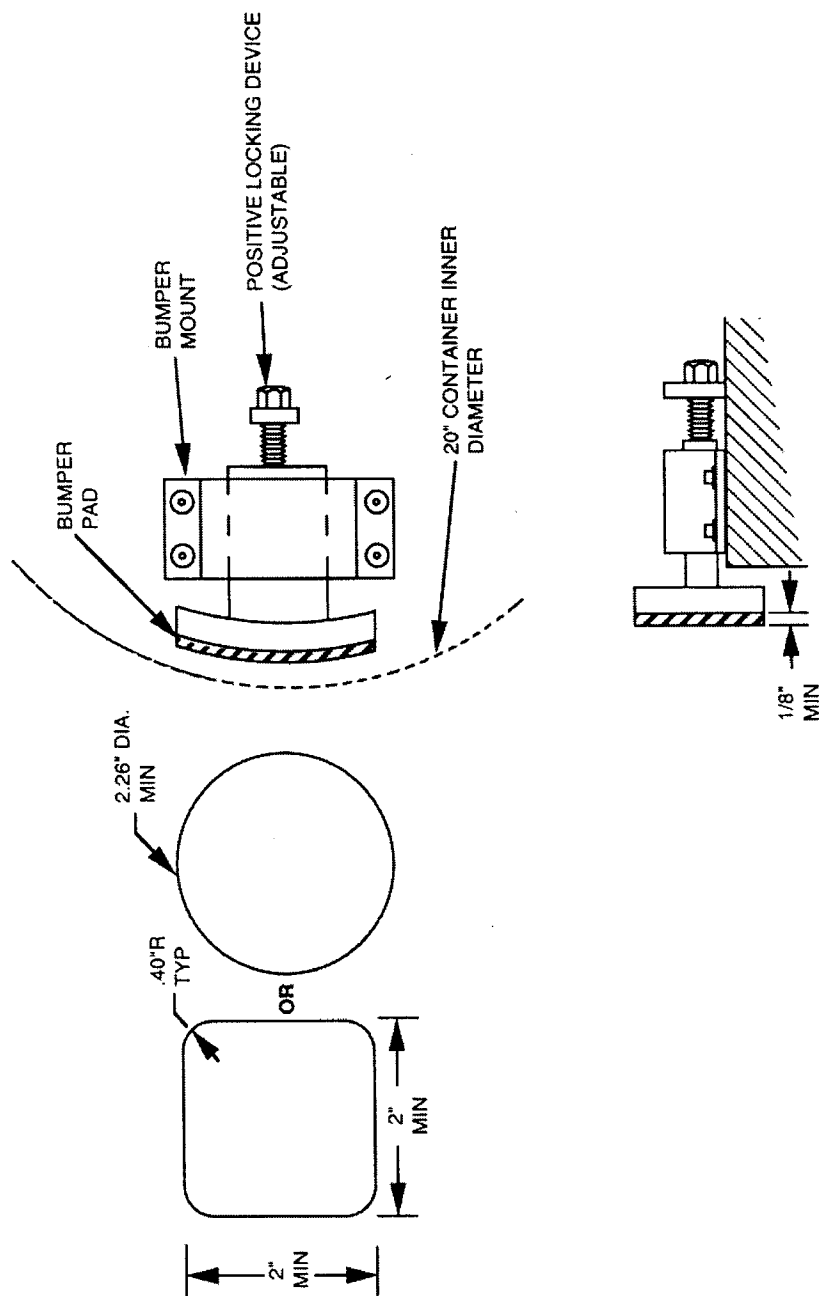


FIGURE 2.16 BUMPER DESIGN EXAMPLE

2.1.1.7 Customer Emblems

HH customers may attach a logo or emblem to the exterior of their equipment. Emblems may also be attached to the exterior of canisters containing customer equipment. The canister emblems should be on a .010 inch Lexan sheet 11 inches square. Emblem artwork must be submitted to GSFC for NASA approval. Materials used for emblems must meet all Space Shuttle payload bay materials requirements.

2.1.2 Plate Mounting

Experiment packages which are not best suited for the canister approach may be mounted on a plate (see Figure 2.17). A small HH-S plate is capable of supporting experiment packages of up to 300 pounds, mounted on an area 25" x 39". Customer equipment is attached to the core plate using a grid hole pattern on 2.756" (70-mm) centers with 3/8" - 24 UNF stainless steel bolts. The bolts are supplied by the HH Project. A similar matrix of #10 - 32 mounting bolt locations will be used by the HH staff to route interface cables as well as intercomponent harnessing and plumbing. The experiment structural dimensions and attachment points at the mounting plate interface must be reviewed for acceptance by the HH Project.

2.1.2.1 Experiment Package Integrity

The package must be designed, fabricated, inspected, analyzed, and tested to demonstrate the ability to constrain, or to contain, the elements of the experiment package during launch, flight, and landing. All customer equipment shall be designed to withstand limit acceleration load factor limits as stated in Section 3.1.1.3.2. Also refer to Random Vibration Verification Levels given in Section 3.1.1.5.3 (Table 3.6).

2.1.2.2 Experiment Package Volume

Specific volume restrictions other than those provided in Section 2.1 are not generally placed on customer equipment since the equipment mass and CG location are the controlling factors. In general, the experiment CG should be located as close to the mounting interface as practical. The complexity of the weight/CG relationship, the possibility of multiple customers per plate, manifesting considerations, and other factors require that the HH-S staff perform accommodation assessments on a case-by-case basis. Guidance will be provided to determine specific equipment design and accommodation details as part of the normal mechanical interface documentation exchange.

Hitchhiker-S Experiment Mounting Plate

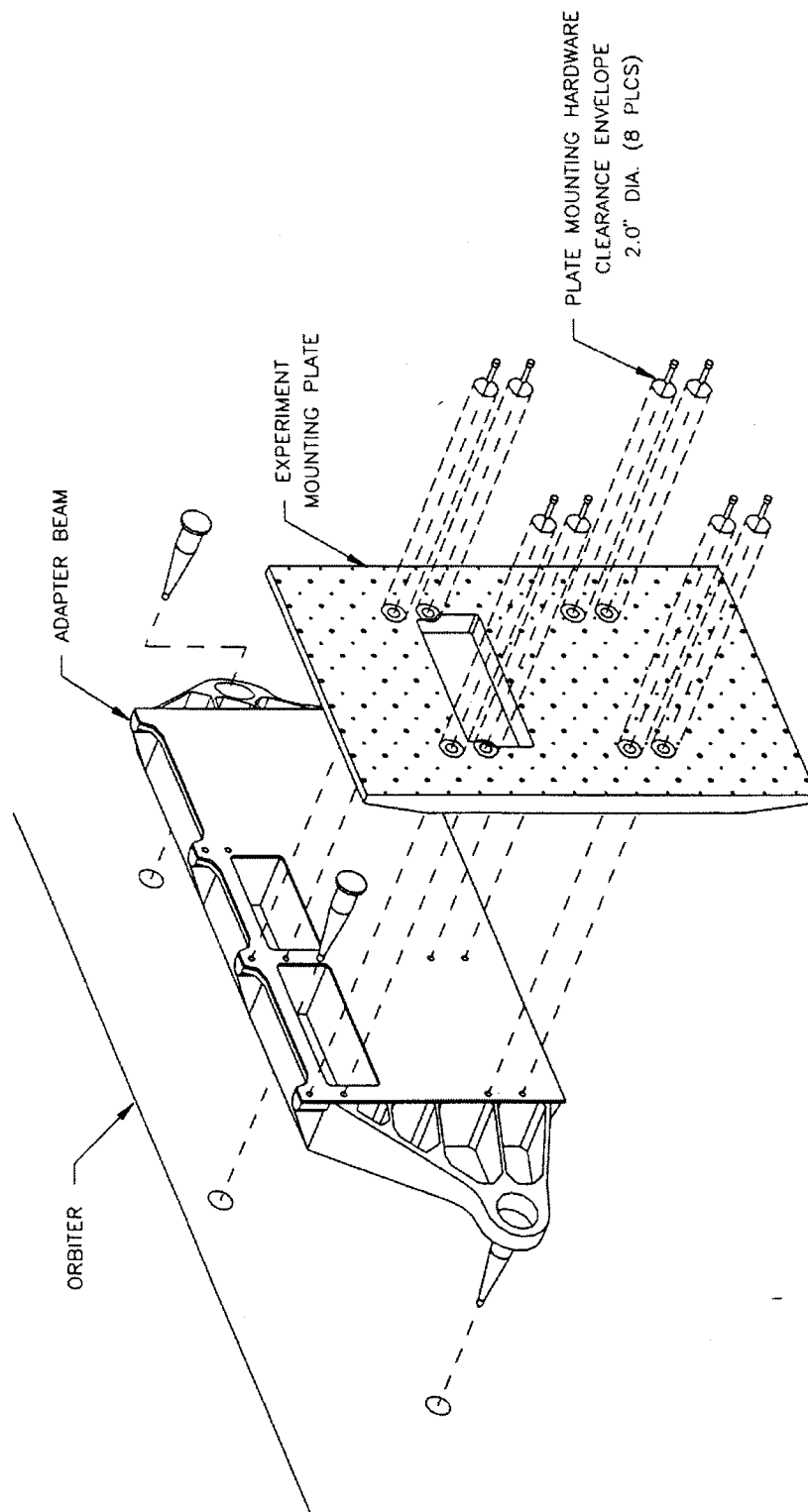


FIGURE 2.17 HITCHHIKER-S EXPERIMENT MOUNTING PLATE

2.1.2.3 Mounting Bolt Loading Limitations

The mounting bolts must be included in the payload stress and fracture analysis (see Section 3.0). Bolt strength and material data will be supplied by the HH Project.

2.1.3 Direct Mounting of Experiment Package

The maximum weight-carrying configuration in the current HH-S system is accomplished by mounting the customer's flight unit directly to the Adapter Beam Assembly (ABA). This mode will accommodate up to 700 pounds but requires detailed case-by-case analysis and approval. The mounting hardware between the experiment package and the ABA will be supplied by the HH Project. The available experiment mounting locations are noted in Figure 2.18.

2.1.3.1 Experiment Package Integrity

See 2.1.2.1 for design considerations.

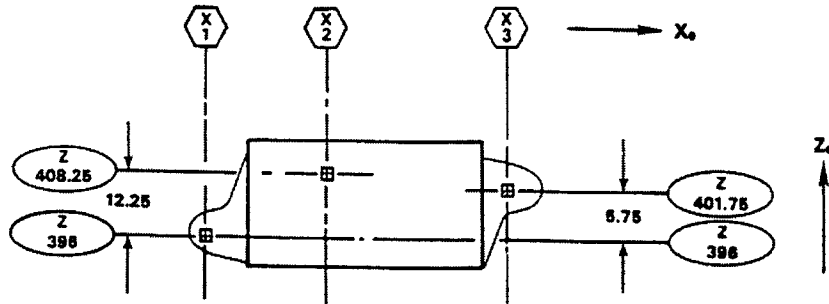
2.1.3.2 Experiment Package Volume and Mounting Limitations

The experiment volume in the direct mount configuration can be somewhat higher than in the plate mount setup; however, it is similarly restricted as described in subsections 2.1.2.2 and 2.1.2.3. The HH staff provides assistance in adapting customer hardware to the ABA interface and defining CG and volume restrictions. Direct-mount payloads are normally designed to be mounted on the adapter beam after the beam is installed in the Orbiter. The mounting scheme must be simple and involve captive fasteners. In the event that a payload is designed to mount on the beam prior to Orbiter installation, adequate access to the longeron bolts must exist. Special lifting equipment for hoisting the payload/beam combination must also be provided.

2.1.4 HH-C Structure

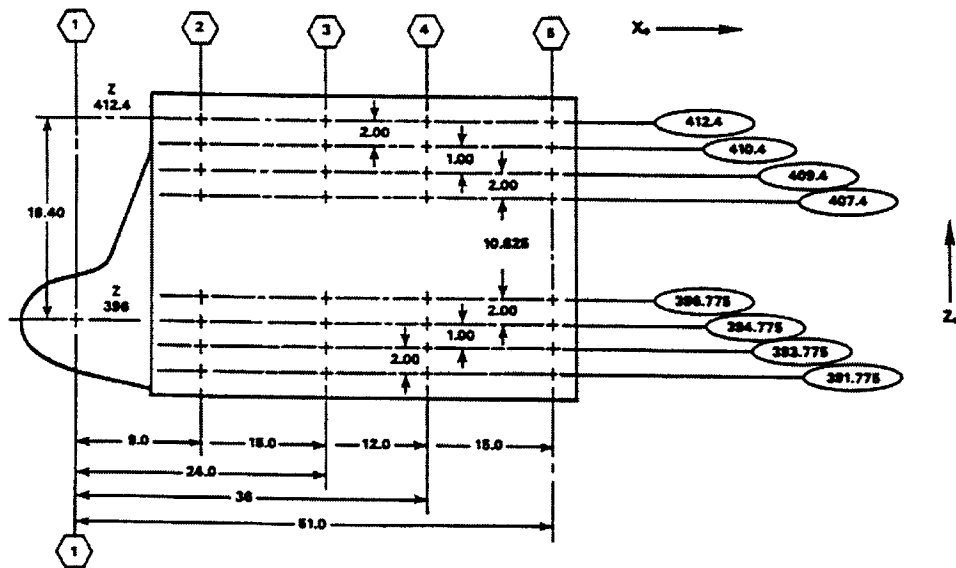
The HH-C cross-bay carrier is implemented using a truss structure (Figure 2.19) called the Hitchhiker Bridge Assembly (HHBA). The HHBA is similar to other Mission Peculiar Experiment Support Structure (MPSS) structures used on Spartan, GAS, Materials Science Laboratory (MSL), and other NASA payload programs and consists of an upper support structure and a lower support structure. The lower structure is normally attached to the upper structure at the launch site. During integration and transportation to the launch site, the upper structure is mounted on a special dolly (see Figure 2.20) which allows easier access and handling.

Adapter Beam Mounting Interfaces



X	X AXIS BAY							
	1	2	3	4	5	6	7	8
1		636.0	693.0	750.0	807.0	863.0	919.0	979.5
2		649.0	715.0	776.90	833.0	892.5	951.0	1011.40
3		693.0	750.0	807.0	863.0	919.0	979.5	1040.0

Longeron Bolt Access Locations



X	X AXIS BAY							
	1	2	3	4	5	6	7	8
1		636.0	693.0	750.0	807.0	863.0	919.0	979.5
2		645.0	702.0	759.0	816.0	872.0	928.0	988.5
3		660.0	717.0	774.0	831.0	887.0	943.0	1003.5
4		672.0	729.0	786.0	843.0	899.0	955.0	1015.5
5		687.0	744.0	801.0	858.0	914.0	970.0	1030.5

Adapter Beam Mounting Locations

FIGURE 2.18 ADAPTER BEAM MOUNTING INTERFACES

Hitchhiker-C Payload

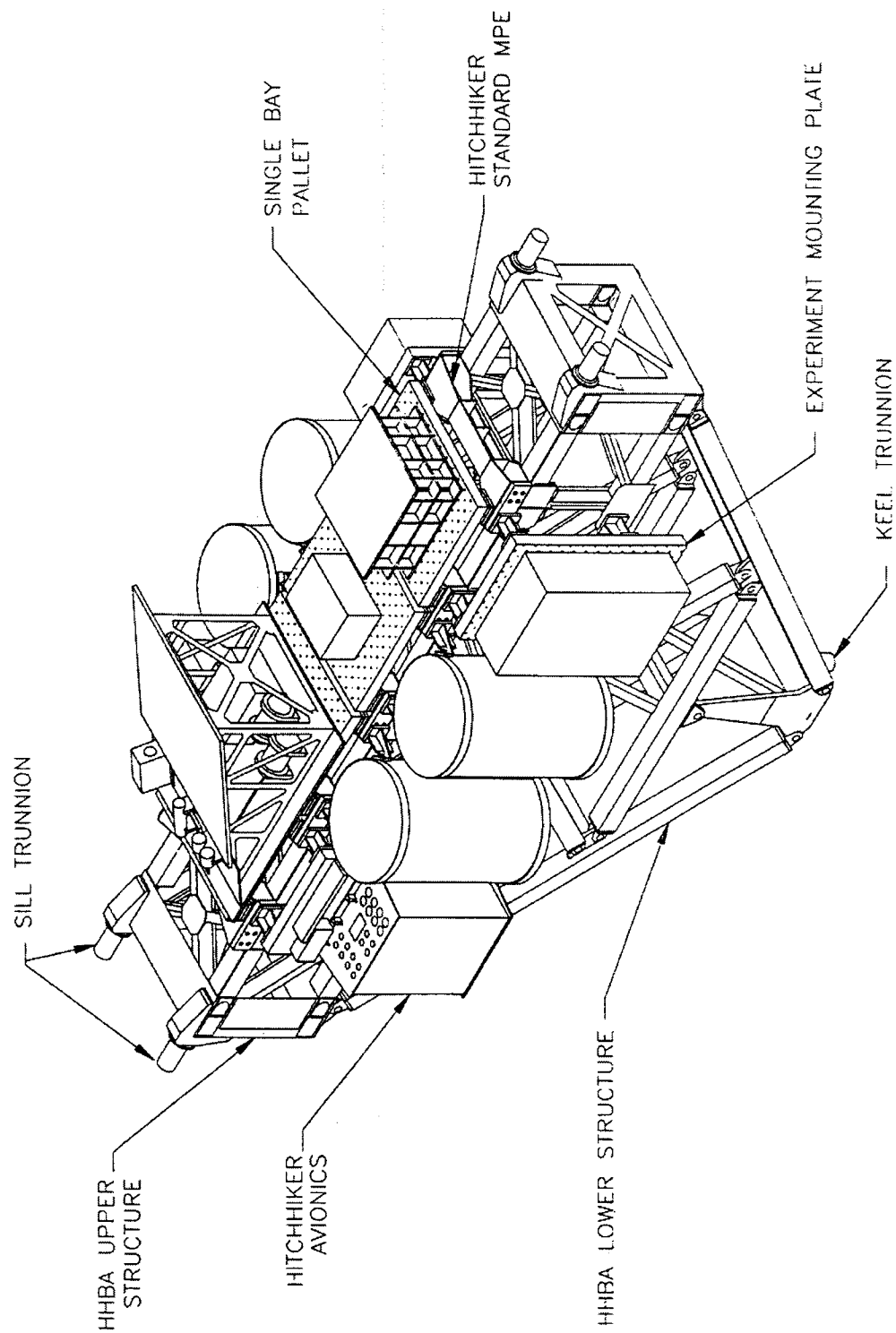


FIGURE 2.19 HITCHHIKER-C PAYLOAD

HHBA Upper Structure on Shipping Dolly

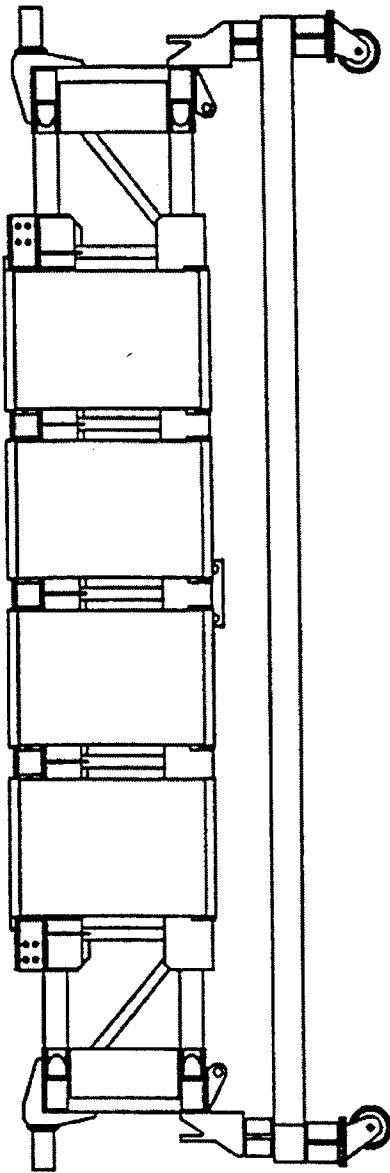


FIGURE 2.20 HHBA UPPER STRUCTURE ON SHIPPING DOLLY

2.1.4.1 Standard HHBA

Attachment of payload equipment to the HHBA is done by means of special Mission Peculiar Equipment (MPE), structure elements which can be attached to the HHBA in five different locations spaced 28.20 inches apart across the top and sides of the structure. The standard MPE has eight positions on the sides of the HHBA for side experiment mounting plates and canisters. However, one experiment mounting plate position is reserved for the HH avionics. Of the remaining seven positions, three can be used for side experiment mounting plates or canisters. The other four positions can only be used for canisters. The HHBA and MPE are un-insulated and can experience large temperature deviations during a mission. For this reason, special mounting brackets are used to attach the plates and canisters to the MPE. The brackets provide thermal isolation and allow for thermal expansion when plates or canisters are temperature controlled.

The top of the MPE structure has positions for two sizes of top plates. It will accommodate two large top plates, four small top plates or combination thereof. Customers considering accommodation on the HHBA should request drawing number GE1550253 from the HH Project for additional detailed information beyond what is listed in the following sections.

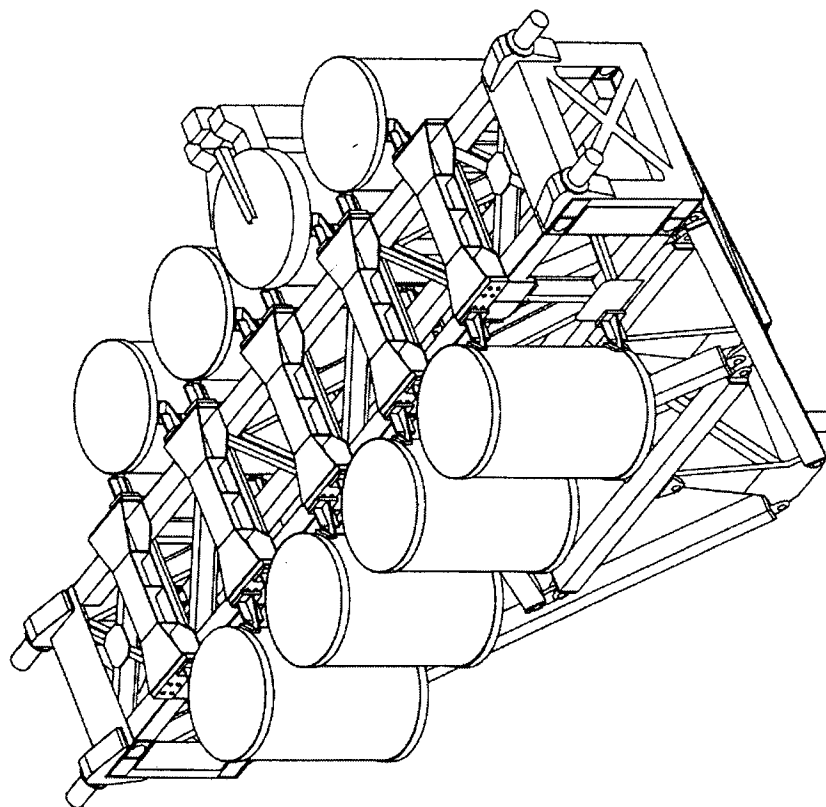
2.1.4.3 HH-C Canisters

Canisters identical to those specified for HH-S can be used with the HH-C. The canister is rotated 90 degrees about the Z axis in the HH-C case. All possible canister locations are shown in Figures 2.21, 2.22, and 2.23. Figure 2.21 shows the HH-C Canister Locations. Figure 2.22 shows the HH-C Canister and Mounting Plates, and Figure 2.23 shows the HH-C Canister highlighting the Y-Axis Coordinates and Field-of-View Restrictions

2.1.4.4 HH-C Side Mounting Plates

The HH-C side mounting plates (shown in Figure 2.24) are functionally identical to, although not interchangeable with, the small HH-S mounting plates. The plates are 25" x 39" and can support up to 250 pounds. The "Y" and "Z" axis coordinates of these plates and the field-of-view restrictions are shown in Figure 2.25.

Hitchhiker-C Canister Locations



NOTE:

The Avionics will use one of the side plate locations as shown in Figure 2.24.

FIGURE 2.21 HITCHHIKER-C CANISTER LOCATIONS

Hitchhiker-C Canister and Mounting Plates

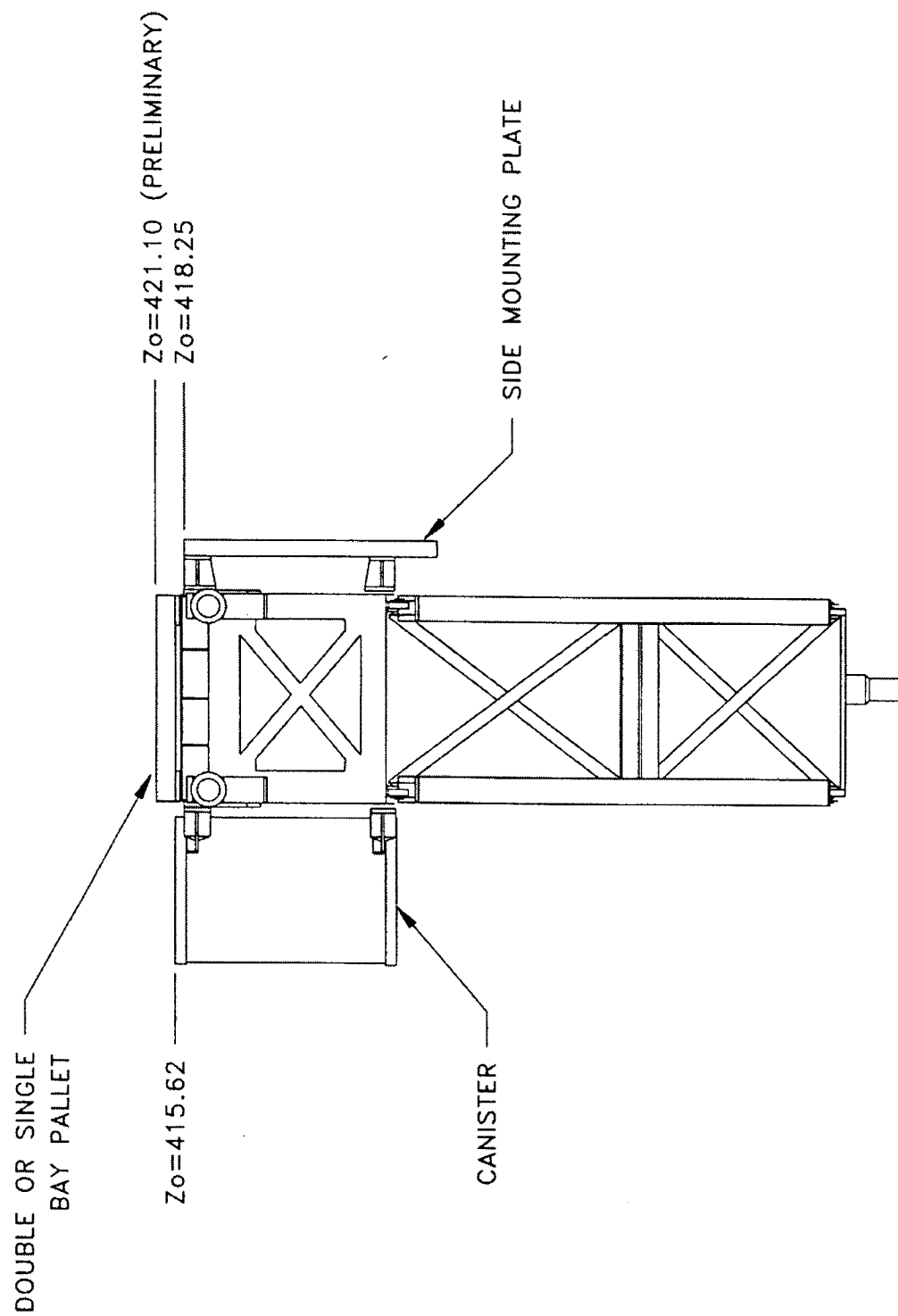


FIGURE 2.22 HITCHHIKER-C CANISTER AND MOUNTING PLATES

Hitchhiker-C Canister Y-Axis Coordinates and Field-of-View Restrictions (Looking Aft)

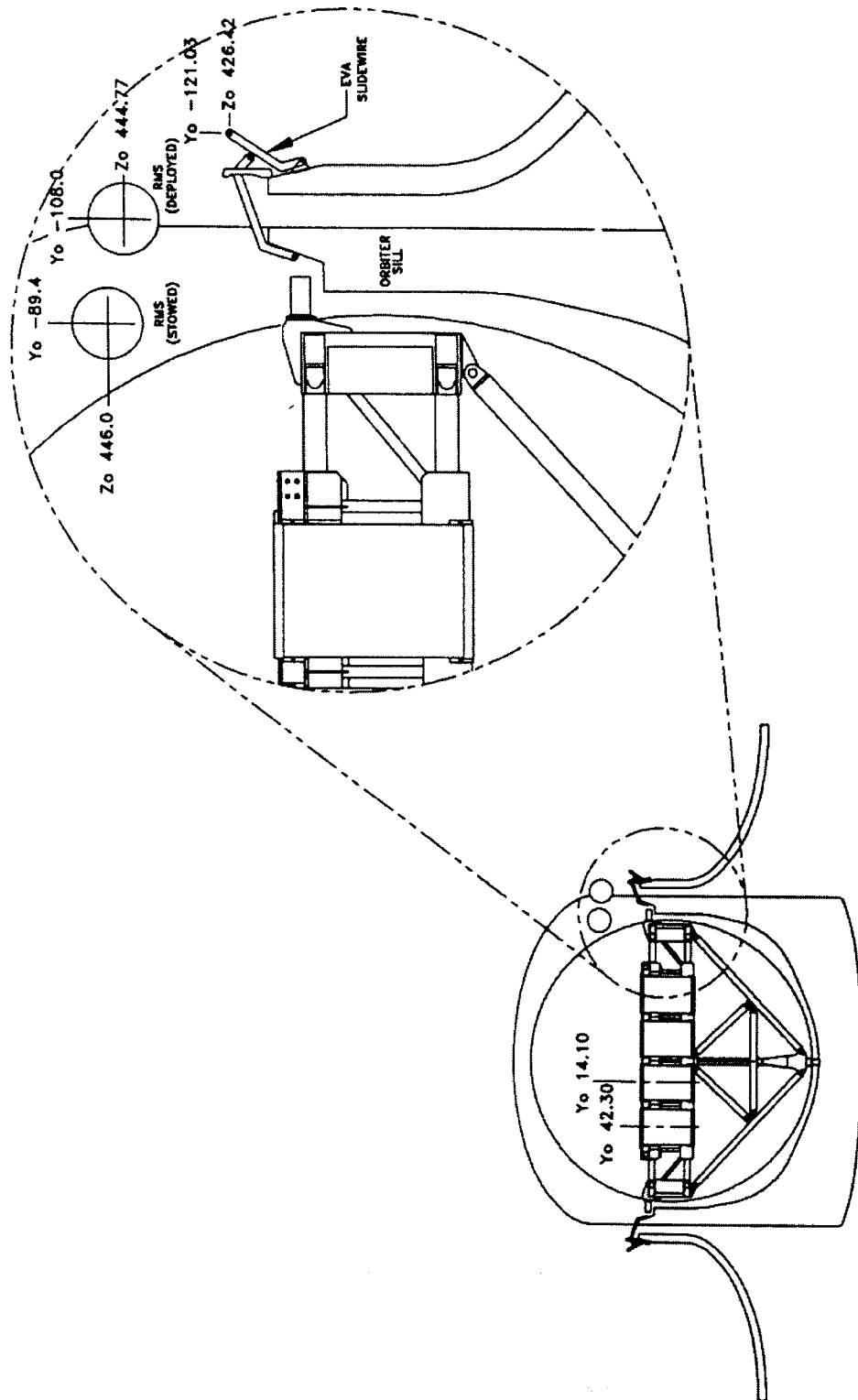


FIGURE 2.23 HITCHHIKER-C CANISTER

Hitchhiker-C Mounting Plate Locations

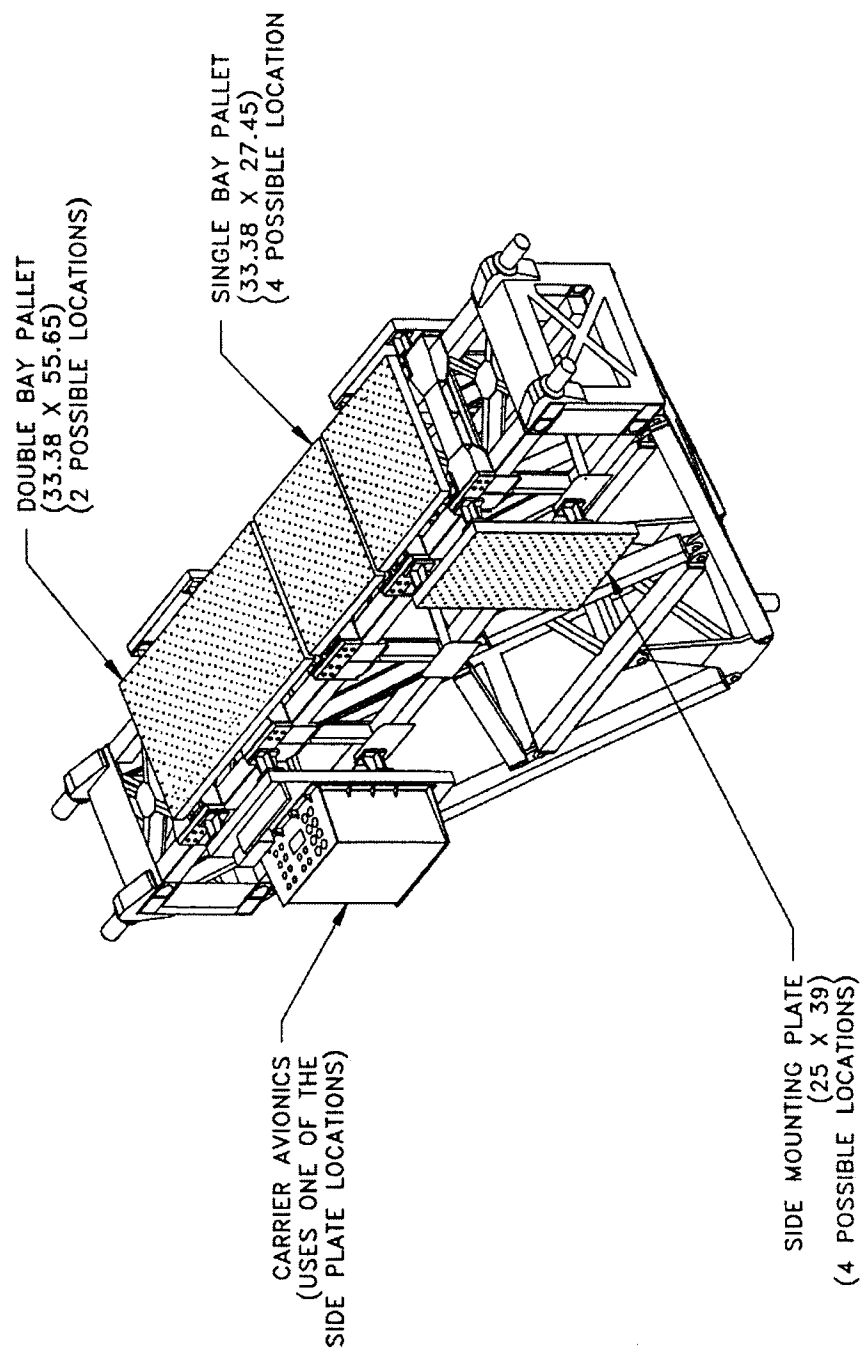


FIGURE 2.24 HITCHHIKER-C MOUNTING PLATE LOCATIONS

Hitchhiker-C Mounting PlateY-Axis Coordinates and Field-of-View Restrictions (Looking Aft)

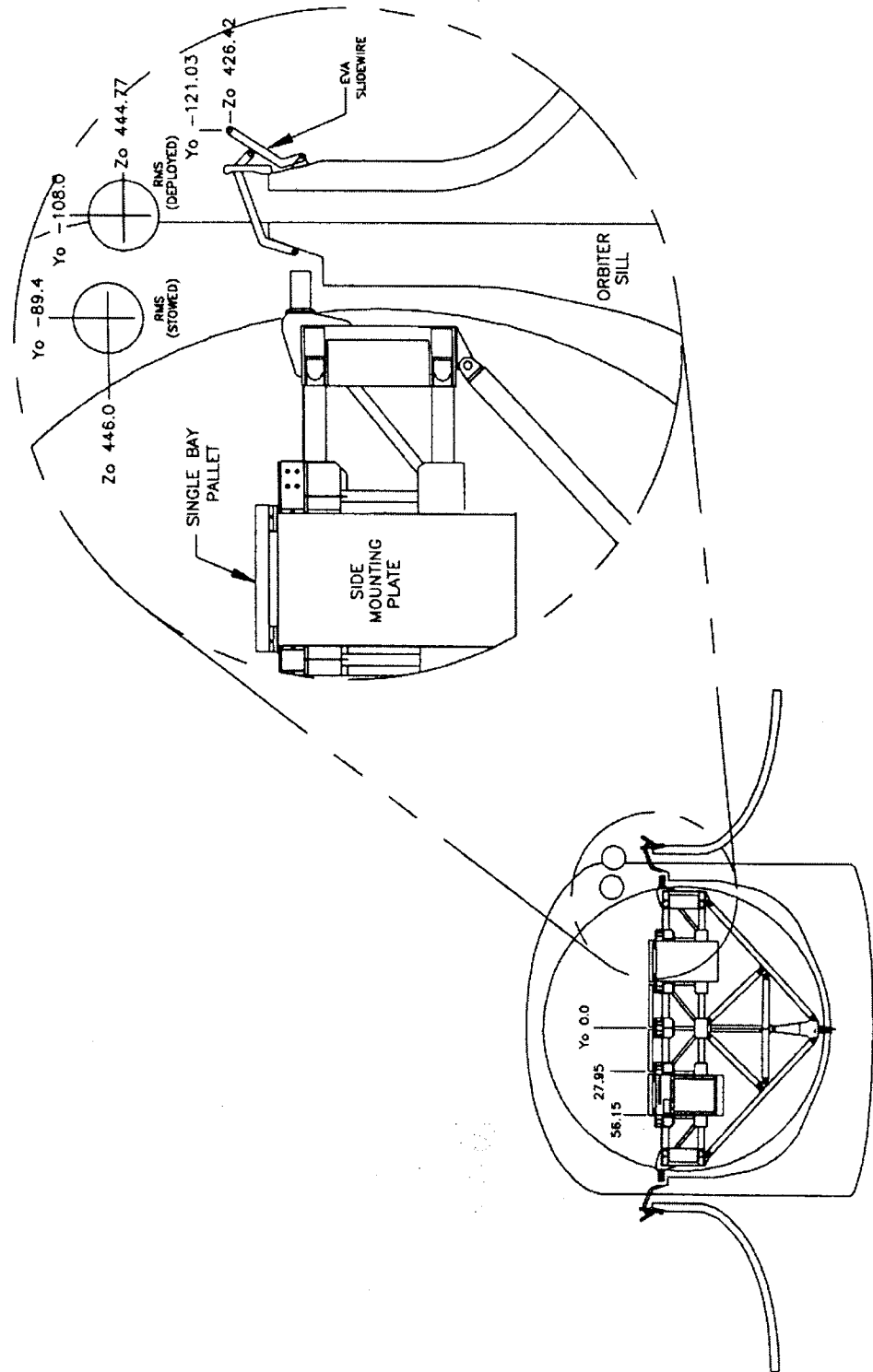


FIGURE 2.25 HITCHHIKER-C MOUNTING PLATE

2.1.4.5 HH-C Top Mounting Pallets

The HH-C top mounting pallets are also shown in Figure 2.24. Their field-of-view restrictions are shown in Figure 2.25. The small pallet is roughly 33" by 27". The large pallet is roughly 33" by 56". Both pallets can handle up to 600 pounds, provided the center of gravity of the experiment hardware is within the design envelopes as shown in Figure 2.26.

2.1.4.6 HH-C Direct Mounting

Large/heavy customer equipment which is not suitable for accommodation on the standard plates or canisters may be attached directly to existing HH MPE or may be attached to the structure by means of new customer-unique MPE, provided by GSFC as an optional service. Hardware mounting locations are shown in Figure 2.27. In either case, the customer's structural design must safely accommodate larger differential temperature changes between his/her equipment and the carrier. Proposals for direct mounting should be sent to the HH project for evaluation.

2.1.5 HH Side Mounting Plates

The HH side mounting plate is a generic plate combining the capabilities of the HH-S and HH-C side plates.

CG Envelope & Positions

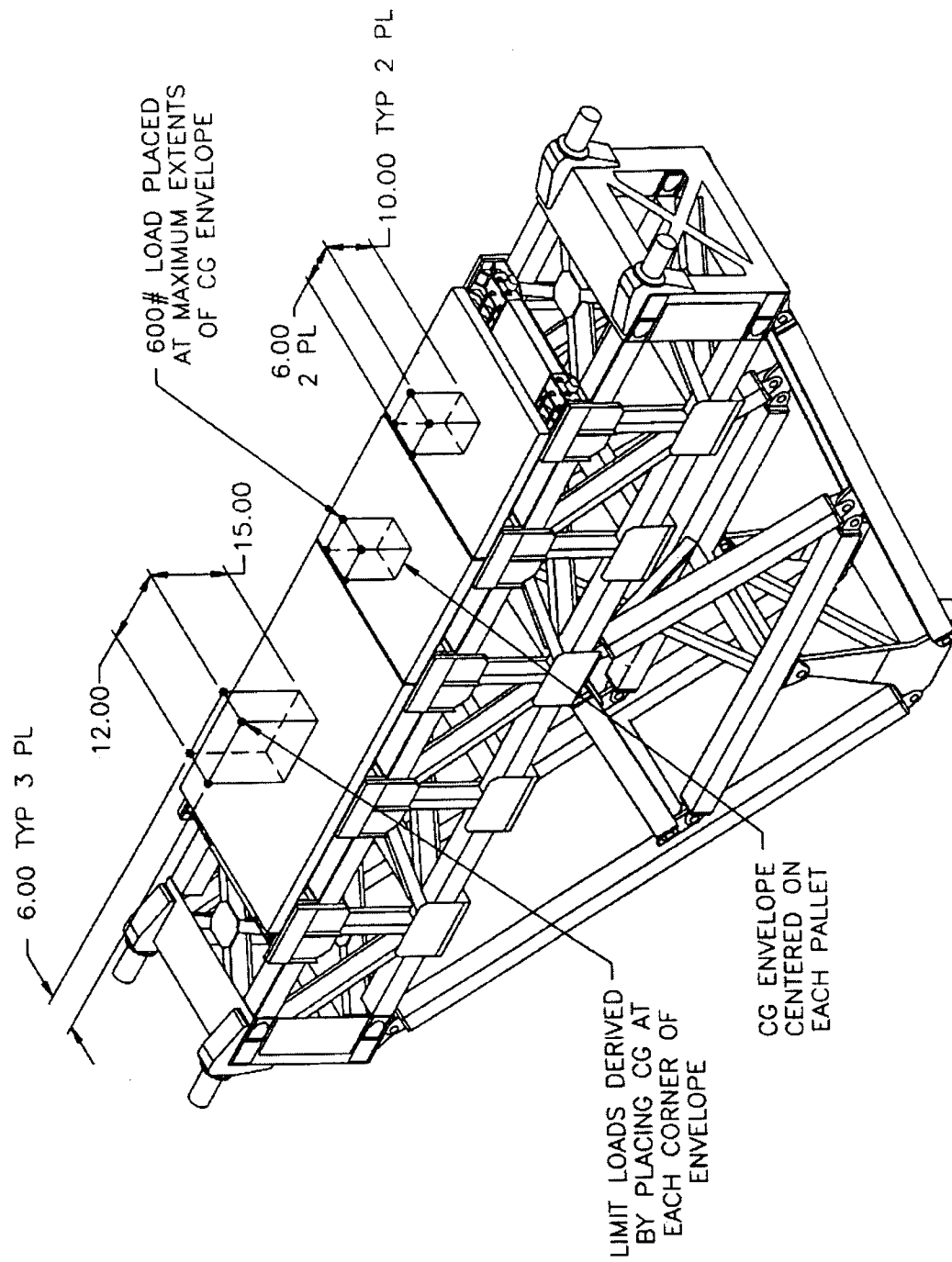


FIGURE 2.26 CG ENVELOPE & POSITIONS

Technical drawing of a mechanical assembly, likely a pump or engine component, showing a side view with dimensions and labels.

Labels and dimensions include:

- SYM** (Symmetry line)
- Q** (Reference point)
- 4X 8.200** (Dimension across the top)
- 20X 2.000** (Dimension across the top)
- .662 DIA - 96 HOLES** (Label for the top holes)
- 4X 17.800** (Dimension across the top)
- 4X 28.200** (Dimension across the top)
- 4X 66.880** (Dimension across the top)
- 4X 17.800** (Dimension across the top)
- 20X 2.250** (Dimension across the top)
- 2X 32.415** (Dimension across the top)
- 2X 3.000** (Dimension across the top)
- 2-414.00** (Dimension across the top)
- 4X 17.855** (Dimension across the top)
- 4X 28.445** (Dimension across the top)
- 18X 1.500** (Dimension across the top)
- 4X 17.310** (Dimension across the top)
- 4X 66.125** (Dimension across the top)
- (.248)** (Dimension across the bottom)
- (8.856)** (Dimension across the bottom)
- (17.310)** (Dimension across the bottom)
- G** (Reference point)
- CAN** (Label for the bottom component)

The X numbers (i.e., 4X, 20X, etc.) indicate the number of occurrences of this dimension over the entire structure, two halves both near side and far side.

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